REGISTER

OF

THE LEHIGH UNIVERSITY,

1890-1891.

TUITION FREE.

SOUTH BETHLEHEM, PA.
1890.

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THE LEHIGH UNIVERSITY,

SOUTH BETHLEHEM, PA.,

1890-1891.

FOUNDED BY ASA PACKER.

TUITION FREE.

BETHLEHEM, PA.:
TIMES PUBLISHING COMPANY.
1890.

TABULAR ALMANAC.

1890.

JULY.

S	M	T	W	T	F	S
...	...	1	2	3	4	5
6	7	8	9	10	11	12
13	14	15	16	17	18	19
20	21	22	23	24	25	26
27	28	29	30	31	...	...
...	...	...	...	...	...	...

AUGUST.

S	M	T	W	T	F	S
...	...	...	...	...	1	2
3	4	5	6	7	8	9
10	11	12	13	14	15	16
17	18	19	20	21	22	23
24	25	26	27	28	29	30
31	...	...	...	...	...	...

SEPTEMBER.

S	M	T	W	T	F	S
...	1	2	3	4	5	6
7	8	9	10	11	12	13
14	15	16	17	18	19	20
21	22	23	24	25	26	27
28	29	30	...	...	...	...
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OCTOBER.

S	M	T	W	T	F	S
...	...	...	1	2	3	4
5	6	7	8	9	10	11
12	13	14	15	16	17	18
19	20	21	22	23	24	25
26	27	28	29	30	31	...
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NOVEMBER.

S	M	T	W	T	F	S
...	...	...	...	...	...	1
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9	10	11	12	13	14	15
16	17	18	19	20	21	22
23	24	25	26	27	28	29
30	...	...	...	...	...	...

DECEMBER.

S	M	T	W	T	F	S
...	1	2	3	4	5	6
7	8	9	10	11	12	13
14	15	16	17	18	19	20
21	22	23	24	25	26	27
28	29	30	31	...	...	...
...	...	...	...	...	...	...

1891.

JANUARY.

S	M	T	W	T	F	S
...	...	...	...	...	1	2	3
4	5	6	7	8	9	10
11	12	13	14	15	16	17
18	19	20	21	22	23	24
25	26	27	28	29	30	31
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FEBRUARY.

S	M	T	W	T	F	S
1	2	3	4	5	6	7
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MARCH.

S	M	T	W	T	F	S
1	2	3	4	5	6	7
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15	16	17	18	19	20	21
22	23	24	25	26	27	28
29	30	31	...	...	...	...
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APRIL.

S	M	T	W	T	F	S
...	...	...	1	2	3	4
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12	13	14	15	16	17	18
19	20	21	22	23	24	25
26	27	28	29	30	...	...
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MAY.

S	M	T	W	T	F	S
...	...	...	...	...	1	2
3	4	5	6	7	8	9
10	11	12	13	14	15	16
17	18	19	20	21	22	23
24	25	26	27	28	29	30
31	...	...	...	...	...	...

JUNE.

S	M	T	W	T	F	S
...	1	2	3	4	5	6
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14	15	16	17	18	19	20
21	22	23	24	25	26	27
28	29	30	...	...	...	...
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JULY.

S	M	T	W	T	F	S
...	...	...	1	2	3	4
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12	13	14	15	16	17	18
19	20	21	22	23	24	25
26	27	28	29	30	31	...
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AUGUST.

S	M	T	W	T	F	S
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9	10	11	12	13	14	15
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SEPTEMBER.

S	M	T	W	T	F	S
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13	14	15	16	17	18	19
20	21	22	23	24	25	26
27	28	29	30	...	...	...
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OCTOBER.

S	M	T	W	T	F	S
..	...	...	...	1	2	3
4	5	6	7	8	9	10
11	12	13	14	15	16	17
18	19	20	21	22	23	24
25	26	27	28	29	30	31
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NOVEMBER.

S	M	T	W	T	F	S
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15	16	17	18	19	20	21
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DECEMBER.

S	M	T	W	T	F	S
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13	14	15	16	17	18	19
20	21	22	23	24	25	26
27	28	29	30	31	...	...
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1892.

JANUARY.

S	M	T	W	T	F	S
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10	11	12	13	14	15	16
17	18	19	20	21	22	23
24	25	26	27	28	29	30
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FEBRUARY.

S	M	T	W	T	F	S
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MARCH.

S	M	T	W	T	F	S
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13	14	15	16	17	18	19
20	21	22	23	24	25	26
27	28	29	30	31	...	...
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APRIL.

S	M	T	W	T	F	S
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10	11	12	13	14	15	16
17	18	19	20	21	22	23
24	25	26	27	28	29	30
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MAY.

S	M	T	W	T	F	S
1	2	3	4	5	6	7
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15	16	17	18	19	20	21
22	23	24	25	26	27	28
29	30	31	...	...	...	.
...	...	...	...	...	...	...

JUNE.

S	M	T	W	T	F	S
..	...	1	2	3	4
5	6	7	8	9	10	11
12	13	14	15	16	17	18
19	20	21	22	23	24	25
26	27	28	29	30	31	...
...	...	...	...	...	...	...

CALENDAR.

1890. 1890-1891.

Sept. 6, 8, 9,	Saturday, Monday and Tuesday,	Examinations for Admission.
Sept. 10,	Wednesday,	First Term begins.
Oct. 9,	Thursday,	Founder's Day.
Nov. 27,	Thursday,	Thanksgiving Day.
Dec. 17,	Wednesday,	First Term ends.

1891.

Jan. 6, 7,	Tuesday and Wednesday,	Examinations for Admission to Second Term.
Jan. 7,	Wednesday,	Second Term begins.
Jan. 17,	Saturday,	Junior Prize Orations due
Feb. 11,	Wednesday,	Ash Wednesday.
Feb. 22,	Sunday,	Washington's Birthday.
March 26,	Thursday,	Easter Holidays begin.
March 31,	Tuesday,	Easter Holidays end at $8\frac{1}{4}$ A.M.
May 25,	Monday,	University Day Orations due.
May 27,	Wednesday,	Theses of Seniors due.
May 27,	Wednesday,	Senior Examinations begin.
June 8,	Monday,	Annual Examinations begin.
June 14,	Sunday,	Baccalaureate Sermon.
June 15,	Monday,	Class Day.
June 16,	Tuesday,	Alumni Day.
June 17,	Wednesday,	University Day.
June 18, 19, 20,	Thursday, Friday and Saturday,	Examinations for Admission.

1891. 1891-1892.

Sept. 5, 7, 8,	Saturday, Monday and Tuesday,	Examinations for Admission.
Sept. 9,	Wednesday,	First Term begins.
Oct. 8,	Thursday,	Founder's Day.
Nov. 26,	Thursday,	Thanksgiving Day.
Dec. 16,	Wednesday,	First Term ends.

1892.

Jan. 5, 6,	Tuesday and Wednesday,	Examinations for Admission to Second Term.
Jan. 6,	Wednesday,	Second Term begins.
June 15,	Wednesday,	University Day.

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M.E.—Mechanical Engineering.
Met.—Metallurgy.
E.E.—Electrical Engineering.

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Conrad Egbert Hesse, B.S.,	E.M.,	Mt. Carmel.
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R. Swain Perry, A.C.,	M.S.,	Piedmont, Ala.

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John Bonner Semple,	A.C.,	Pittsburg.
Cass Knight Shelby,	M.E.,	Grand Rapids, Mich.
*James Causten Shriver,	C.E.,	Cumberland, Md.
*Charles Henry Simpson,	C.E.,	Pensacola, Fla.
Philip Henry Smith,	E.E.,	Parsippany, N. J.
*Robert Jones Snyder,	M.E.,	Bethlehem.
Lester Warren Walker,	E.E.,	North Platte, Neb.
*David Hykes Witmer,	C.E.,	Annville.
Frederic Wittman,	A.C.,	Lanark.
Charles Oaks Wood,	M.E.,	Chambersburg.
*Byron Edgar Woodcock,	C.E.,	Altoona.

SOPHOMORE CLASS.

	Course.	Residence.
Harry Doughten Appleby,	C.E.,	Wilmington, Del.
Miltiades Themistocles Armas,	C.E.,	Trebizond, Asia Minor.
George Haldeman Atkins,	C.E.,	Pottsville.
Harry Jacobs Atticks,	E.E.,	Lisburn.
Joseph Clinton Ballou,	A.C.,	Becket, Mass.
*Clarence Earle Belfield,	E.E.,	Philadelphia.
Edward Keating Bishop,	M.E.,	Chicago, Ill.
Herman Renner Blickle,	C.E.,	Cincinnati, O.
William Irvin Boyd,	C.E.,	Washington, D. C.
Fred. Edgar Bray,	C.E.,	Industry.
Rezeau Blanchard Brown,	M.E.,	Somerville, N. J.

* Not clear of conditions.

	Course.	Residence.
Gilbert Forbes Burnett,	Sci.,	New Providence, N.J.
Ellis Buchanan Byllesby,	L.S.,	Allegheny.
George Edward Chamberlain,	A.C.,	Pittston.
*Morris Llewellyn Cooke,	M.E.,	South Bethlehem.
Warren Fellman Cressman,	C.E.,	Sellersville.
*John P. Culbertson, jr.,	E.E.,	Chambersburg.
Walter Joseph Dech,	Clas.,	Bethlehem.
Jacob De Haan,	E.E.,	Leeuwarden, Nether-
Alden Brown Diven,	C.E.,	Elmira, N. Y. [lands.
Charles Malcolm Douglas,	Clas.,	Belvidere, N. J.
Robert Arthur Downey,	C.E.,	Oswego, N. Y.
Charles Hazard Durfee,	E.E.,	Fall River, Mass.
Bernard Dennis Enright,	A.C.,	South Bethlehem.
Henry Brown Evans,	M.E.,	Dayton, O.
Robert Ferriday,	C.E.,	South Bethlehem.
Arthur Haldeman Fetters,	M.E.,	Barneston.
George Harwood Frost,	M.E.,	Plainfield, N.J.
Frederick Pardee Fuller,	E.E.,	Scranton.
Robert Foster Gadd,	C.E.,	Sudlersville, Md.
Charles Willits Gearhart,	E.E.,	Danville.
Dorr Lawton Gessner,	E.E.,	Fremont, O.
Gustavus A. Gessner, jr.,	A.C.,	Fremont, O.
Harvey Hartzell Godshall,	A.C.,	Lansdale.
*Samuel Laury Graham, jr.,	E.M.,	Pinewood, Tenn.
George Hervey Hallett,	Clas.,	Pottsville.
Lee Stout Harris,	C.E.,	Silver Brook.
Claude Sanford Haynes,	C.E.,	Elmira, N. Y.
Richard Willis Heard,	E.E.,	Augusta, Ga.
Robert Culbertson HaysHeck,	M.E.,	Heckton Mills.
*Bayly Hipkins,	M.E.,	Oakland, Md.
William Emley Holcombe,	E.E.,	Lambertville, N. J.

* Not clear of conditions.

	Course.	Residence.
George Cass Hutchinson,	M.E.,	Sewickley.
Turie Seibert Ickes,	C.E.,	Newport.
John Elmer Jones,	E.M.,	Hazleton.
*William Stricklar Jones,	E.M.,	Greensburg.
Charles Lincoln Keller,	M.E.,	Chicago, Ill.
Herman Eugene Kiefer,	A.C.,	Altoona.
Schuyler Brush Knox,	C.E.,	Carthage Landing,
Harry Donaldson Leopold,	C.E.,	Tamaqua. [N.Y.
Frank Sigismund Loeb,	A.C.,	Columbia.
Owen Francis Luckenbach,	M.E.,	Bethlehem.
William Price Marr,	E.E.,	Shamokin.
Joseph O. Mathewson, jr.,	E.M.,	Augusta, Ga.
Archibald Stewart Maurice,	C.E.,	Athens.
George Holbrooke Maurice,	C.E.,	Athens.
James Edgar Miller,	C.E.,	Chicago, Ill.
William Frederick Mylander,	C.E.,	Baltimore, Md. [Mont.
Hiram Dryer McCaskey,	E.M.,	Fort Assineboine,
Matthew McClung, jr.,	C.E.,	Knoxville, Tenn.
Charles Louis McKenzie,	C.E.,	Binghamton, N. Y.
John Douglas McPherson, jr.,	E.E.,	Washington, D.C.
Clinton Ledyard Olmsted,	C.E.,	Eagle Village, N. Y.
Charles Joseph O'Neill,	E.E.,	Washington, D. C.
Nathaniel M. Osborne, jr.,	M.E.,	Norfolk, Va.
Charles William Parkhurst,	E.E.,	Hammonton, N. J.
Duncan White Patterson,	M.E.,	Safe Harbor.
John Gates Peck,	C.E.,	Stow, Mass.
Andrew Pinter,	M.E.,	Miskolcz, Hungary.
*Mervin Paul Randolph,	E.E.,	Atglen.
Raymond Bernard Randolph,	A.C.,	Montclair, N. J.
John Graham Reid,	C.E.,	Danville.
Francis Evans Richards,	C.E.,	Columbus, Miss.

* Not clear of conditions.

	Course.	Residence.
*George William Ritchey,	L.S.,	Pittsburg.
Lewis Daniel Rights,	C.E.,	Bethlehem.
Frederick Brittan Sage,	E.E.,	Hackensack, N. J.
Martin Luther Saulsbury,	C.E.,	Ridgely, Md.
*Edmund Munroe Sawtelle,	E.E.,	Washington, D. C.
Joseph A. Schloss,	A.C.,	Elmira, N. Y.
Armin Schotte,	C.E.,	New York City.
Frank Schutte,	M.E.,	Philadelphia.
William Frederick Semper,	A.C.,	Philadelphia.
Alexander Beatty Sharpe,	E.M.,	Steubenville, O.
Adelbert Sheldon,	C.E.,	Royalton, N. Y.
Noel W. Smith,	C.E.,	Williamsport.
Edward Augustus Soleliac,	M.E.,	Allentown.
Alfred Earnest Speirs,	Clas.,	Bethlehem.
George Stern,	Clas.,	Frostburg, Md.
William Renick Stinemetz,	E.E.,	Washington, D. C.
John Taylor, jr.,	A.C.,	Bethlehem.
*Wilson Jones Taylor,	C.E.,	Edgmont.
C. Wickliffe Throckmorton,	M.E.,	Fort Schuyler, N. Y.
Lewis Esler Troutman,	M.E.,	Pottsville.
Orson William Trueworthy,	E.E.,	Washington, D. C.
Jacob Von Maur,	C.E.,	West Pittston.
Fred Conover Warman,	C.E.,	Washington, D. C.
William J. Weatherby,	E.M.,	Swedesboro, N. J.
James Horatio Westcott, jr.,	Sci.,	Wilmington, Del.
John Lewis Williams,	E.M.,	Wilkes Barre.

* Not clear of conditions.

FRESHMAN CLASS.

	Course.	Residence.
Henry Adams,	A.C.,	South Bethlehem.
*Alvord Anderson,	A.C.,	Montclair, N. J.
*William Conklin Anderson,	E.E.,	New York City.
David Balliet,	C.E.,	Normal Square.
William Maclay Bard,	E.E.,	Washington, D. C.
Robert Josiah Bartholomew,	M.E.,	Bath.
Geo. Washington Scott Baton,	C.E.,	Philadelphia.
Irvin Isaac Beinhower,	M.E.,	Steelton.
Haldeman Bigler,	A.C.,	Harrisburg.
Henry M. A. Blun, jr.,	E.E.,	Savannah, Ga.
Thomas Joseph Bray, jr.,	M.E.,	Warren, O.
Charles Sumner Bricker,	M.E.,	Lititz.
*Lawrence Calvin Brink,	C.E.,	Frenchtown, N. J.
Ernott Davis Buel,	C.E.,	Cumberland, Md.
John Salmon Carman,	A.C.,	Washington, D. C.
William Colwell Carnell,	A.C.,	Philadelphia.
Thomas Francis Carroll,	L.S.,	Long Valley.
Robert Edes Chetwood, jr.,	E.E.,	Elizabeth, N. J.
Edward Perrine Cody,	C.E.,	Philadelphia.
William Wheeler Coleman,	E.M.,	South Bethlehem.
*Homer Frank Cox,	E.E.,	Wellsboro.
*Henry Benning Crawford,	C.E.,	Columbus, Ga.
Mott Cessna Cunningham,	Sci.,	Youngstown, O.
George Milton Curtis, jr.,	A.C.,	New York City.
John Denman, jr.,	M.E.,	Kendall Creek.
John Patrick Donohoe,	E.M.,	Greensburg.
Beekman DuBarry, jr.,	M.E.,	Washington, D. C.

* Not clear of conditions.

	Course.	Residence.
Paris Milton Dunnington,	E.M.,	Minneapolis, Minn.
Walter Sewell Dunscomb,	C.E.,	Brooklyn, N. Y.
*Stephen Elliott,	C.E.,	Beaufort, S. C.
Thaddeus Percival Elmore,	C.E.,	Elmira, N. Y.
Theodore Gwathmey Empie,	E.E.,	Wilmington, N. C.
Albert Brodhead Enbody,	C.E.,	Mauch Chunk.
Alfred Howell Exton,	E.M.,	High Bridge, N. J.
Benjamin Franklin Faust,	E.E.,	Berwick.
James DuBose Ferguson,	C.E.,	Washington, D. C.
Richard Daniel Floyd,	A.C.,	Milton, Mass.
John Jacob Frank,	E.E.,	Columbia.
Andrew Gallagher,	E.E.,	South Bethlehem.
Albert Ross Gee,	E.E.,	Fall River, Mass.
Frank Wieseman Glading,	E.E.,	Philadelphia.
Milton Brayton Graff,	A.C.,	Glendale, O.
Elwood Aristides Grissinger,	E.E.,	Mechanicsburg.
Samuel Wilbur Grubb,	C.E.,	Philadelphia.
Bayard Guthrie,	E.E.,	Fort Sill, Indian Ty.
Peter Wilson Hairston,	E.E.,	Walnut Cove, N. C.
William McCleery Hall,	C.E.,	Lancaster.
*Fletcher Dickerman Hallock,	E.E.,	Plainfield, N. J.
Robert Rieman Harvey,	E.E.,	Wilkes Barre.
Arthur Williston Henshaw,	E.E.,	Amherst, Mass.
Anton Yost Hesse,	C.E.,	Bethlehem.
Ira Miller Higbee,	C.E.,	Watsontown.
Foster Haven Hilliard,	C.E.,	Beltsville, Md.
William Jacob Hiss, jr.,	E.E.,	Baltimore, Md.
Matthias Harry Holz,	E.E.,	Philadelphia.
Alfred A. Howitz,	M.E.,	West Pittston.
James Edward Hughes,	Clas.,	Philadelphia.
Geo. Washington Hunsicker,	A.C.,	Allentown,

* Not clear of conditions.

	Course.	Residence.
Charles Borrows Jacobs,	E.M.,	South Bethlehem.
Henry Scudder Jaudon,	C.E.,	Savannah, Ga.
Fred. Kittredge Jenney,	Clas.,	Kansas City, Mo.
Guillermo Enrique Jimeno,	M.E.,	Bananquilla, U.S. Col-
*Victor Albert Johnson,	E.M.,	St. Paul, Minn. [ombia.
Barry Holme Jones,	E.M.,	Bethlehem.
Wm. Harrison Kavanaugh,	M.E.,	Williamsport.
Henry Whitman Kern,	M.E.,	Chicago, Ill.
Robert Burt Kernohan,	E.M.,	Warren, O.
Henry Edward Kip,	Arch.,	Buffalo, N. Y.
Richard Warren Knight,	C.E.,	Hammonton, N. J.
Clifton Cookman Knorr,	C.E.,	Bloomsburg.
*Louis John Krom,	A.C.,	Plainfield, N. J.
*Claude Averett Langdon,	C.E.,	Chambersburg.
*Edward Kent Leech,	E.E.,	Washington, D. C.
*Arthur Hughes Lewis,	Sci.,	Plains.
James Edwin Little,	M.E.,	Hokendauqua.
John Thomas Little,	A.C.,	Hokendauqua.
Philip Theodore Lovering,	E.E.,	Minneapolis, Minn.
Clarence Oliver Luckenbach,	M.E.,	Bethlehem.
Edward Marsh,	A.C.,	Ridley Park.
John Vansickle Martenis,	M.E.,	South Bethlehem.
Fred. Chandler Mathewson,	E.M.,	Pomfret, Conn.
William Spencer Merrill,	Clas.,	Cincinnati, O.
Walter Chambers Miller,	A.C.,	Sewickley.
Walter Henry Miller,	M.E.,	Osage City, Kan.
Rudolph C. Möllman,	E.E.,	Germantown.
Charles Asher Moore,	C.E.,	Hammonton, N. J.
*George Hamilton Moorhead,	C.E.,	Harrisburg.
Spencer Mussey,	A.C.,	Washington, D. C.
Arthur McAllister, jr.,	C.E.,	Cleveland, O.

* Not clear of conditions.

	Course.	Residence.
Francis Marion McCullough,	E.E.,	Altoona.
*Matthew McHugh,	M.E.,	South Bethlehem.
Carl Wm. Frederick Neuffer,	C.E.,	Scranton.
Charles Atwood Newbaker,	E.E.,	Danville.
Alphonso Robert Nicholson,	A.C.,	Jenkintown.
Richard Leslie Ogden,	A.C.,	Shenandoah.
Godwin Ordway,	E.M.,	Washington, D. C.
Englebert Glover Ovenshine,	C.E.,	Fort Davis, Tex.
Jeremiah Francis O'Hearn,	C.E.,	Shenandoah.
Edward Boteler Passano,	M.E.,	Baltimore, Md.
William Arthur Payne,	Arch.,	Brooklyn, N. Y.
Benjamin Rush Petrikin,	E.E.,	Lock Haven.
William Vaughan Pettit, jr.,	E.M.,	Philadelphia.
Joseph Philips, jr.,	E.M.,	Nashville, Tenn.
Van Dyke Piper,	E.E.,	Bethlehem.
Wilbur Orton Polhemus,	C.E.,	Nyack, N. Y.
William Miller Purman,	M.E.,	Washington, D. C.
Edmund Payton Ramsey,	E.E.,	Washington, D. C.
*Charles Allen Rea,	E.E.,	Mill Green, Md.
Joel Howard Reber,	E.E.,	Allentown.
Homer Austin Reid,	C.E.,	Warren, O.
Jas. Clement Richardson, jr.,	E.E.,	Glendale, O.
Samuel Neely Riter,	M.E.,	Corapolis.
Luis Rivas,	M.E.,	New York City.
*Thomas Charles Roderick,	C.E.,	Canal Dover, O.
Frank William Roller,	M.E.,	Bethlehem.
Charles Beecher Rutter,	E.M.,	Lansford.
Clement Clarence Rutter,	C.E.,	Lansford.
Herman Schneider,	Arch.,	Summit Hill.
Benj. Ferdinand Schomberg,	M.E.,	Altoona.
E. A. Schuman,	E.M.,	Santiago de Cuba.

* Not clear of conditions.

	Course.	Residence.
John Scanlin Scott,	E.E.,	Wilkes Barre.
Edgar Earnest Seyfert,	C.E.,	Pine Grove.
George Elwood Shepherd,	E.E.,	Wilkes Barre.
Edward Miles Shepp,	C.E.,	Tamaqua.
Charles Elder Shipley,	E.E.,	Baltimore, Md.
Howard Barry Shipley,	C.E.,	Baltimore, Md.
Edwin Harrison Sigison,	E.E.,	Buffalo, N. Y.
Robert Eugene Smith,	M.E.,	West Bethlehem.
Charles Smithers,	E.E.,	New York City.
Francis Sidney Smithers, jr.,	E.E.,	New York City.
Richard Andrew Lee Snyder,	M.E.,	Carlisle.
Herbert Ridley Stratford,	A.C.,	Jersey City, N. J
Walter Christian Swartz,	M.E.,	Allentown.
Frederick George Sykes,	E.E.,	Apponang, R. I.
Charles Baldwin Teal,	E.E.,	Elizabeth, N. J.
Walter Allison Thacher,	C.E.,	Moorestown, N. J.
*Charles Hamilton Thompson,	E.E.,	Berryville, Va.
Elmer Grant Tice,	L.S.,	Bethlehem.
Alfred Dana Tidball,	E.E.,	South Bethlehem.
*Philip Henry Trout, jr.,	E.E.,	Staunton, Va.
Clarence Porter Turner,	E.E.,	Wilkes Barre.
Charles W. Underwood,	E.E.,	Shepherdstown.
John Moore Van Cleve,	E.E.,	Sewickley.
Everett Pike Van Mater,	M.E.,	Washington, D. C.
John Harrison Walker,	C.E.,	Scranton.
Alonzo Leach Ware,	C.E.,	Ocean City, N. J.
Edward Olmsted Warner,	E.E.,	Salisbury, Conn.
Winfield Lemuel Warner,	M.E.,	Brooklyn, N. Y.
Ruel Chaffee Warriner,	E.M.,	Montrose.
John Eugene Weideman,	E.E.,	Washington, D. C.
Howard Perry Weir,	M.E.,	New York City.

* Not clear of conditions.

	Course.	Residence.
John Ignatius Welsh,	E.E.,	Shamokin.
Aubrey Weymouth,	C.E.,	Richmond, Va.
Joseph Wheeler, jr.,	E.E.,	Wheeler, Ala.
Henry Blackstone Wilkins,	A.C.,	Baltimore, Md.
Thomas William Wilson,	E.E.,	Harrisburg.
Walter Lyne Wilson,	E.E.,	Washington, D. C.
Weldon Burris Wooden,	C. E.,	Hampstead, Md.
Charles Rusk Yerrick,	M.E.,	Danville.

SPECIAL STUDENTS.

	Course.	Residence.
Frank Collins,	E.E.,	Smyrna, Del.
Augustus Francis Horne,	A.C.,	Allentown.
Hagime Ichikawa,	A.C.,	Tokio, Japan.
Albert Edward Juhler,	A.C.,	Pomeroy, O.
Emil Herman Mohr,	E.E.,	Philadelphia.
Joseph Gillis Patterson, jr.,	L.S.,	Philadelphia.
Winston Kent Pendleton,	A.C.,	Eustis, Fla.
Stephen Collins Potts,	A.C.,	Altoona.
Frank Hiram Walker, B.S.,	C.E.,	Kilbourn, Wis.
Robert J. Waltman,	E.E.,	Bethlehem.
George Francis Weida,	A.C.,	Lawrence, Kan.
Frank Shriver West,	A.C.,	Philadelphia.

SUMMARY OF STUDENTS BY STATES.

New Hampshire,	1
Massachusetts,	8
Rhode Island,	1
Connecticut,	3
New York,	35
New Jersey,	26
Pennsylvania,	208
Delaware,	3
Maryland,	18
District of Columbia,	24
Virginia,	6
North Carolina,	3
South Carolina,	3
Georgia,	9
Alabama,	3
Florida,	2
Mississippi,	1
Kentucky,	2
Tennessee,	3
Ohio,	22
Illinois,	6
Michigan,	1
Wisconsin,	1
Minnesota,	5
Missouri,	1
Kansas,	2
Nebraska,	2

Texas,	1
Colorado,	1
Montana,	1
Indian Territory,	1
Cuba,	3
Porto Rico,	1
U. S. of Colombia,	2
Canada,	1
Netherlands,	1
Hungary,	1
Asia Minor,	1
Japan,	1
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SUMMARY OF STUDENTS BY CLASSES AND COURSES.

	Graduates.	Seniors.	Juniors.	Sophomores.	Freshmen.	Specials.	Totals.
Classical,	6	3	3	5	3	—	20
Latin-Scientific,	2	1	—	2	2	1	8
Science and Letters,	2	—	—	2	2	—	6
Civil Engineering,	3	20	21	34	38	1	116
Mechanical Eng.,	1	7	11	18	28	—	63
Mining Eng.,	10	6	13	8	15	—	52
Electrical Eng.,	—	11	10	19	50	3	91
Analytical Chem.,	3	7	3	11	18	7	47
Architecture,	—	1	—	—	3	—	4
Totals,	27	56	61	99	159	12	414

THE LEHIGH UNIVERSITY.

ORIGIN.

The Hon. ASA PACKER, of Mauch Chunk, during the year 1865, appropriated the sum of Five Hundred Thousand Dollars, to which he added one hundred and fifteen acres of land in South Bethlehem, to establish an educational institution in the rich and beautiful Valley of the Lehigh. From this foundation rose THE LEHIGH UNIVERSITY, incorporated by the Legislature of Pennsylvania in 1866. In addition to these gifts, made during his lifetime, Judge Packer by his last will secured to the University an endowment of $1,500,000, and to the University Library one of $500,000.

DESIGN.

The original object of Judge Packer was to afford the young men of the Lehigh Valley a complete education, technical, literary and scientific, for those professions represented in the development of the peculiar resources of the surrounding region. In furtherance of this purpose instruction is liberally provided in Civil, Mechanical, Mining and Electrical Engineering, Chemistry, Metallurgy, Architecture, and in all needful collateral studies. A School of General Literature is also established and thoroughly equipped, with three departments, called respectively the Classical, the Latin-Scientific, and that of Science and Letters. These departments are kept up to the standard, and the requirements for entrance are the same as those of our best Classical and Literary institutions.

FREE TUITION.

All these educational facilities are provided without charge. Through the generosity of the founder, the Trustees were enabled, in 1871, to declare tuition FREE in all

branches and classes. The Lehigh University is open to young men of good character and suitable preparation from every part of our own land and of the world. To this fact the attention of the pupils of our public schools and of the graduates of classical institutions is especially called. Thus is offered, *without charge*, every facility for studying the professions of the Civil, Mechanical, Mining and Electrical Engineer, and of the Metallurgist, the Analytical Chemist and Architect. In the Classical and Scientific departments of the School of General Literature instruction is given in the Classics, Science and Letters.

PUBLIC WORSHIP.

Prayers are held in the Packer Memorial Church of the University every morning and all students are required to be present.

Divine service is held every Sunday morning in the church. The service is according to the forms of the Protestant Episcopal Church, under whose auspices the University was placed by its Founder. Attendance is required of every student, except in case of those connected with other religious bodies, to whom the President will grant permission at the beginning of each term (if requested by the parent or guardian, or by the student himself if he be 21 years of age) to attend during that term the place of worship of the body with which he is connected, where attendance on Sunday morning will be required.

SITE.

The situation of the institution is healthful and beautiful. The region is famous for its railway and manufacturing enterprises; it possesses some of the richest iron and coal mines in our land, and thus gives the students rare facilities for confirming the teachings of the recitation room by the observation of the eye.

The University buildings are about a half-mile from the depot, at the junction of the Lehigh Valley and North Pennsylvania Railroads. New York is ninety-two and Philadelphia fifty-four miles distant.

BUILDINGS.

PACKER HALL,

named after the Founder, stands seven hundred feet back of Packer Avenue, at the base of the South Mountain. It is built of stone, and contains Lecture and Recitation Rooms, the Drawing Rooms and the Museum of Geology and Natural History.

THE CHEMICAL LABORATORY

is thoroughly fire-proof, is built of sandstone, and is 219 feet in length by 44 in width.

There are two principal stories and a basement. The upper floor is occupied by the quantitative and the qualitative chemical laboratories, the former accommodating 48 and the latter 84 students. These rooms are 20 feet in height, and are well lighted and ventilated. A laboratory for industrial chemistry and the supply room are also on this floor.

The first floor contains a large lecture room, a recitation room, a chemical museum and laboratories for organic, physiological, agricultural and sanitary chemistry.

In the basement is the large laboratory for the furnace assay of ores and a well appointed laboratory for gas analysis, also rooms containing the apparatus for several processes in industrial chemistry, the engine and air-pump for vacuum filtration, a store room and the toilet.

A photographic laboratory is located in the third story of the central portion of the building.

THE METALLURGICAL LABORATORY

contains a lecture room, a blowpipe laboratory for class instruction in blowpipe analysis and in the practical determination of crystals and minerals, a museum for mineralogical and metallurgical collections, a mineralogical laboratory provided with a Fuess reflecting goniometer, a polariscope, a Groth's "universal apparat" and a Rosenbusch polarizing microscope, a dry laboratory provided with furnaces for solid fuel and for gas with natural draught and with blast, and a wet laboratory for ordinary analytical

work. It is arranged for the instruction of classes in the courses of mineralogy, metallurgy and blowpipe analysis of the regular curriculum, and to afford facilities to a limited number of advanced students for familiarizing themselves with the methods of measurement and research employed in mineralogy and metallurgy, and for conducting original investigations in these departments of science.

THE PHYSICAL LABORATORY

consists of three stories. A large lecture room, with a seating capacity of 150, occupies a portion of the second and third floors. It is well lighted and adapted to its purposes. On the remainder of these floors are two rooms, each 40 feet long, for Heat and Light laboratories, a dark room for photographic work, spectroscopic and apparatus rooms and the private laboratories of the Instructors.

The lower floor is devoted to the use of the students in Electricity. A large room nearly 40 feet square is used as the Electrical Laboratory. There are smaller rooms for photometric and spectroscopic work, also reading, balance, apparatus and engine rooms. On this floor a 12 horse-power high speed engine and a dynamo supply two systems of electric lights, one of 25 incandescent lights, the other of four arc lights, for practical tests in the Electrical Laboratory and for experimental purposes in the lecture room above. In the cellar are battery, store rooms, etc.

The tower and two rooms in the east end of Christmas Hall have been given to the Department of Physics and will be equipped as a Meteorological Observatory.

THE SAYRE OBSERVATORY.

Near Brodhead Avenue is the Sayre Observatory, the gift of Robert H. Sayre, Esq., of South Bethlehem, containing an equatorial and a zenith telescope, transit instrument and astronomical clock.

THE UNIVERSITY LIBRARY.

To the east of Packer Hall is the University Library, erected by the Founder in memory of Mrs. Lucy Packer Linderman, his daughter.

THE GYMNASIUM

is a handsome and spacious structure, built and equipped with the utmost thoroughness. It is furnished with the best patterns of gymnastic apparatus, besides Dr. Sargent's system of Developing Appliances. It is provided with hot and cold water; tub, sponge and shower baths, and 380 clothes closets. Opportunities for recreation and amusement are provided in the bowling alleys. It is under the immediate care of a skilled and competent Director.

All students are required to undergo a physical examination before being allowed the use of the Gymnasium, and this examination will be repeated once each year during their stay at the University. The proper exercise is prescribed and is required of every student. The aim of the institution is to promote a harmonious, symmetrical development suited to the individual condition of the student.

EXPENSES.

Tuition is FREE in all branches and classes. Books, materials, paper, pencils, chemical materials used in the analytical laboratories and drawing instruments are furnished by the student. Materials consumed in the analytical laboratories are furnished to the student by the University at cost prices, their value being covered by a deposit made at the opening of that term in which the laboratory work is to be done.

Rooms and Board can not be had in University buildings, but can readily be obtained in many private houses.

The following is an estimate of the necessary expenses for the collegiate year, clothing and traveling not included :

Board for 40 weeks, . . .	from $160	to $200
Room-rent, with fuel and lights .	40 "	80
Care of room and use of furniture, .	5 "	20
Washing and incidentals, . . .	20 "	40
Books, stationery, etc., . . .	25 "	50
Total, ...	$250	to $390

NOTE.—If clubs be formed the cost of board need not exceed $3.50 per week.

ADMISSION OF STUDENTS.

The Register is intended to give all necessary information concerning the admission of students. Application may be made to the President of the University if information is desired which is not given in the Register.

DATE OF EXAMINATIONS.

Examinations for admission to the University are held at the opening of each term, and also in June at the close of the Academic year.

The examinations for 1891 will be on Tuesday and Wednesday, January 7 and 8, for admission to the *second term;* on Thursday, Friday and Saturday, June 19, 20 and 21, and on Saturday, Monday and Tuesday, September 6, 8 and 9, for admission to the first term. No other examinations for entrance will be held, except for good cause, and all applicants *must* be in attendance at 9 o'clock on the morning of the first day.

The examinations are held in the following order:

First Day.—Geography, 9 A.M.; Arithmetic, 11 A.M.; Physics, 2 P.M.; Latin and Roman History, 2 P.M.

Second Day.—Geometry, 9 A.M.; Physical Geography, 11 A.M.; United States History, 2 P.M.; Grammar, 4 P.M.

Third Day.—Algebra, 9 A.M.; Greek and Greek History, 2 P.M.

CHARACTER OF THE EXAMINATIONS.

The examinations are rigorous and cover the entire ground laid down in the following scheme. They are all conducted in writing, supplemented by an oral examination at the option of the examiner.

Each candidate for admission must be at least sixteen years of age and must present a testimonial of good moral character from his last Instructor, or from the School or

Institute to which he last belonged, or from some reputable citizen of the community in which he lives.

Candidates for admission to

THE CLASSICAL COURSE

will be examined in the following subjects:

1. *English Grammar*, including composition, spelling and punctuation.

2. *Geography*, general and political.

3. *History of the United States*, including the *Constitution*.

4. *Arithmetic*, including the metric system of weights and measures.

5. *Algebra*, Fundamental Principles. Factoring. Least Common Multiple. Greatest Common Divisor. Fractions. Involution. Evolution. Radicals. Imaginary Quantities. Equations of the First and Second Degrees. Ratio. Proportion and Progressions.

[Olney's University Algebra or Meaker's Elements of Algebra is recommended for preparation.]

6. *Geometry*, Fundamental Principles. Rectilinear Figures. The Circle. Proportional Lines and Similar Figures. Comparison and Measurement of the Surfaces of Rectilinear Figures.

[Chauvenet's Geometry (four books) is recommended, that being the text-book used in the University.]

7. *Physical Geography.*

8. *Latin Grammar.*

9. *Cæsar*, four books of the Gallic war.

10. *Cicero*, six orations, including the four against Catiline.

11. *Vergil*, the first six books of the Æneid, including Prosody.

12. The translation, at sight, of passages from Cæsar and Cicero.

13. The translation of English into Latin. (As special importance is given this part of the examination, it is suggested to teachers that they connect exercises in making

Latin, both oral and written, with all the studies of the preparatory course.)

14. *Roman History.* Creighton's Primer of Roman History is suggested as indicating the amount required.

15. *Greek Grammar.*

16. *Xenophon*, Anabasis, four books.

17. *Homer*, Iliad, first three books, including Prosody. The Catalogue of Ships may be omitted.

18. The translation, at sight, of a passage from some work of Xenophon.

19. *Greek History.* Fyffe's Primer of Greek History is suggested.

20. Writing Greek with accents.

The pronunciation of Greek according to the written accents is followed in the University, and it is desirable that students preparing to enter be taught this system.

Latin is pronounced according to the system generally known as the Roman Method.

THE LATIN-SCIENTIFIC COURSE.

Candidates for admission to this course must present the first fourteen of the above requirements, but will substitute for the Greek sections (numbers 15–20 inclusive) the following:

21. *Geometry*, Regular Polygons. Measurement of the Circle. Maxima and Minima of Plane Figures, and Plane and Polyhedral Angles; these constituting the subject matter of Books Five and Six of Chauvenet's Geometry.

THE COURSE IN SCIENCE AND LETTERS.

Candidates for admission to this course are examined in all the subjects demanded of those entering the Latin-Scientific Course, except the Latin and Physical Geography sections (numbers 7–14 inclusive). They will also present the following:

22. *Elementary Physics.*

[Avery's Elements of Natural Philosophy (revised edition) is recommended; also Gage's Elements of Physics, if studied as intended by the author, with practical work in the laboratory by the student and the calculation of problems arising in the work.]

THE SCHOOL OF TECHNOLOGY.

Candidates for admission to the Courses in Civil Engineering, Mechanical Engineering, Mining, Metallurgy, Electrical Engineering, Chemistry and Architecture will be examined in the following subjects:

1. *English Grammar*, including composition, spelling and punctuation. It is recommended that candidates have a knowledge of Latin Grammar, although an examination in it is not required for any courses except the Classical and the Latin-Scientific.

2. *Geography*, general and political.

3. *History of the United States*, including the *Constitution*.

4. *Arithmetic*, including the metric system of weights and measures.

5. *Algebra*, Fundamental Principles. Factoring. Least Common Multiple. Greatest Common Divisor. Fractions. Involution. Evolution. Radicals. Imaginary Quantities. Equations of the First and Second Degrees. Ratio. Proportion and Progressions.

[Olney's University Algebra or Meaker's Elements of Algebra is recommended for preparation.]

6. *Geometry*, Fundamental Principles. Rectilinear Figures. The Circle. Proportional Lines and Similar Figures. Comparison and Measurement of the Surfaces of Rectilinear Figures. Regular Polygons. Measurement of the Circle. Maxima and Minima of Plane Figures, and Plane and Polyhedral Angles; these constituting the subject matter of the first six books of Chauvenet's Geometry.

[Chauvenet's Geometry is recommended, that being the text-book used in the University.]

7. *Elementary Physics.*

[Avery's Elements of Natural Philosophy (revised edition) is recommended; also Gage's Elements of Physics, if studied as intended by the author, with practical work in the laboratory and the calculation of problems arising in the work.]

Division of Entrance Examinations.

Candidates for admission to the Freshman Class may pass all the examinations *at once* in June, or in September, or may take them in *two consecutive years*. In the latter case,

for the Technical courses and the course in Science and Letters, candidates may present themselves for examination in the first year in the following subjects: English Grammar, Geography, History of the United States, and Arithmetic. No credit will be given unless the candidate has passed satisfactorily in at least three subjects at one examination.

The examinations in Algebra, Geometry and Physics must be passed in June or September of that year in which the candidate proposes to enter the University.

In the Latin-Scientific and Classical courses candidates may present themselves for examination in the first year in the following subjects: English Grammar, Geography, History of the United States, Arithmetic, Physical Geography, and Roman History. No credit will be given unless the candidate has passed at least four of the subjects at one examination.

The examination in Latin may also be divided, but no credit will be given unless the candidate has passed in at least three of the topics specified at one examination. The examination in the remaining subjects must be passed in June or September of that year in which the candidate proposes to enter the University.

Candidates intending to enter the University in September are advised to present themselves for examination in June; if they are not fully prepared at that time they will receive credit for the examinations then satisfactorily passed.

CONDITIONAL ADMISSION.

A candidate failing to pass in one or more of the subjects required for admission may, at the discretion of the Faculty, be admitted to his class conditionally, to make up his deficiencies by extra study. When they are made up, he will be received into full standing in his class.

SPECIAL STUDENTS.

Young men of advanced standing who do not desire to take a full regular course, can enter and select special

shorter courses, with the sanction of the Faculty; but in all cases satisfactory examinations must be passed upon the subjects required for entrance to the Freshman Class.

ADMISSION TO ADVANCED STUDIES.

Candidates for admission to advanced studies *in any course* are required to pass, *in addition to the entrance examinations for that course*, examinations in the work already done by the classes which they desire to enter. These examinations are held on the same days as those for entrance to the Freshman Class.

The additional subjects may be found in the program of studies.

A diploma or, in so far as it covers the subjects required for entrance, a certificate of studies taken at another College will be received in lieu of the *Primary Entrance Examinations only.*

ADMISSION TO THE POST-GRADUATE COURSE.

Students of this University who have taken their *first* degree, and others, on presenting a diploma of an equivalent degree conferred elsewhere, are admitted to advanced studies, according to the plan to be found in the Register under the general subject of Graduate Students.

PREPARATORY SCHOOL CERTIFICATES

are not accepted so as to dispense with the primary entrance examinations.

NOTE.—The acceptance of a certificate as evidence of proficiency in lieu of examination is at the discretion of each Professor as to the subjects in his department.

PROGRAM OF STUDIES,

Showing the number of exercises per week for each subject, and the Text-books used.

The following is presented as the general program of instruction, subject to such modifications from time to time as the Faculty may deem expedient, with the approval of the Trustees.

The names of the text-books studied are generally mentioned. The number of exercises per week in each subject is indicated by the figure in parentheses immediately following.

Two hours of drawing, three of work in the laboratory, or three of practice in the field, are regarded as equivalent to a recitation or lecture of one hour's duration.

SCHOOL OF GENERAL LITERATURE.

There are three courses in the School of General Literature of the University.

I. The Classical includes all that is prescribed in our best institutions for the degree of Bachelor of Arts (B.A.). It covers full instruction in Greek, Latin, English, French and German, Mathematics, Astronomy, Physics, Chemistry, Geology, Physiology, Hygiene, History, Psychology, Ethics, Philosophy, Political Economy and Constitutional Law.

II. The Latin-Scientific Course differs from the first in omitting Greek, taking in its place an increased amount of the Modern Languages and of Mathematics. Students completing this course receive the degree of Bachelor of Science (B.S.).

II. The Course in Science and Letters, for which the same degree is given as for the last mentioned, contains no Latin or Greek, but furnishes instead extended instruction

in French and German, History, General Literature, Mathematics and General Science.

Instruction in all of these courses is given both by recitations and by lectures.

DESCRIPTION OF THE COURSES.

GREEK.—During the first term of Freshman year the class reads several books of the Odyssey, giving attention to Epic forms and syntax, to prosody and scanning and to Homeric antiquities and mythology. The work of the second term is directed toward a thorough acquaintance with the idiom and vocabulary of Attic prose, as a preparation for rapid reading. The Œconomicus and Symposium of Xenophon and the Crito of Plato are read during the term, with sight readings from the Memorabilia and the Apology; accompanied by discussions of domestic life at Athens. The work of the year includes a thorough review-drill on the principles of Greek accidence and syntax, and exercises in Greek prose composition are required, based, during the second term, on the reading done by the class. Greek History is studied throughout the year, with special reference to the development of political institutions.

The Sophomore class takes up, during the first term, the study of Herodotus and Thucydides. Selections are made from both authors with the purpose of illustrating their best style and at the same time of presenting, from the original sources, the history of certain interesting epochs; the reading from Herodotus, after some drill on the Ionic forms, being in large part at sight. During the second term the class reads one or two plays of Euripides, with attention to the history of Greek tragedy, the life of the author and the analysis of the drama read. The lyric meters are studied, with the aim of gaining a knowledge of the rhythmical and metrical principles of Greek poetry. During this term an elective course is offered, the subject being Greek oratory, with the reading of certain orations of Lysias or Demosthenes, or both.

The Junior year is devoted to a further study of the drama, selected plays of Sophocles, Aristophanes and Æschylus being read during the year. Work is also done in the study of public and private antiquities, partly in lectures by the professor and partly in original investigation on allotted subjects by the students.

During the first term of the Senior year one of the Dialogues of Plato is read by the class. The second term is in part devoted to the reading of selected odes of Pindar, with careful study of the history of Greek lyric poetry and of the life and work of Pindar in particular. The course concludes with a review of the history of Greek literature, intended to summarize and harmonize the fragmentary views of the general subject gained from the study of particular authors and departments of literature.

Latin.—Much of the training in the Freshman year is devoted to laying a good foundation in Latin Grammar and in the translation of English into Latin. The authors studied are used to illustrate both of these, and a large amount is read at sight in order to cultivate quickness and readiness in the student. Roman History is begun, accompanied with full comments and lectures upon points of interest. Collateral reading will also be recommended each year throughout the course. Cicero: De Senectute and De Amicitia or the Philippics, Livy and the Odes and Epodes of Horace are read this year. With the last named, training is given in Latin meters.

During this and the following year courses of lectures will be given upon Roman Antiquities in addition to a text-book. The topography of Rome with its remains, ancient life in its various aspects, and the other departments of archæology will be discussed, illustrated by the new and extensive set of magic lantern slides which have been prepared for this purpose.

The Sophomore year completes the text-book on Roman History. Prose composition is continued, and the subject of Synonyms taken up in connection with it. The Satires

and Epistles of Horace are read in the first term and in the second the Agricola and Germania, with selections from the Annals of Tacitus, or Quintilian (Bk. X), together with sight reading. An elective in Plautus is offered during this term in addition.

In the Junior year, Selected Letters of Cicero and Pliny are read, followed by Persius and several plays of Terence. The History of Roman Literature is entered upon in the second term.

The work in the Senior year opens with Lucretius, accompanied with lectures on Roman Philosophy. One of Cicero's philosophical treatises, such as the De Officiis, De Finibus, or De Natura Deorum, is taken up in the second term. After the completion of the Roman Literature, lectures will be given upon the History of the Latin Language and upon the Principles of Comparative Philology.

SANSKRIT.—An elementary course in this study, conducted by the Professor of Latin, is offered as an optional during the Senior year.

ENGLISH. — During Freshman and Sophomore years, Rhetoric is studied, both with the aid of a text-book and through practical exercises. Careful training is given in essay writing throughout the course, and orations are written and delivered during Junior and Senior years. Excellence in Oratory is encouraged by the annual contest for the Alumni Prizes, held on the 22d of February and open to the Junior class in all departments.

The Seniors receive instruction in the principles of versification and in extemporaneous discussion, and are required to write a critique of some work selected for their examination.

The History of English Literature and the Philological history of the English language are studied during Junior year. These are supplemented by a series of lectures, extending through the second term, on the relations of Literature to History.

The course is completed by a series of lectures on English and American Literature, delivered during the second term of Senior year.

MODERN LANGUAGES.—The study of modern languages is obligatory from the first term of the Sophomore year up to the close of the course. The student elects either French or German, or both, if time permits.

French.—The grammar is begun, reading being introduced immediately. The comparative and historical relations of the French to the English, and the connection of both with the Latin are carefully explained. As soon as possible the student is emancipated from the reader and takes up, in a progressive way, the reading of different authors: preference being given to modern writers, because it is considered to be of the highest importance that he acquire the language as it is, as an instrument whereby further knowledge can be obtained.

In the class-room, the language taught is used by the teacher as much as possible, in order that the ear of the pupil may become accustomed to its sound. Dictation is also employed, in order to give training in spelling. The rules of grammar are taught by numerous written exercises. In the second term of the Junior year, compositions in French are required, upon subjects which have been previously explained in French, in order that the student may become acquainted with different expressions and forms of construction. Before entering upon the study of an author's works, his life and literary achievements are discussed in French, which is translated, if necessary. In the Senior year, twelve lectures are delivered upon the History of French Literature. In addition to this, lectures in French upon the most distinguished modern authors are given to advanced students.

A weekly conversation-class affords opportunity for this kind of practice: and in it the events of the day and various historical and literary topics are discussed. Private courses of reading are also suggested to those who desire it.

German.—The German course follows the same plan as that laid down for the French, both as regards the methods employed and the opportunities afforded. The relations of English and German are dwelt upon and also those which connect the two languages with the Indo-European family.

MATHEMATICS.—The mathematical work is carried on during the Freshman and Sophomore years as follows:

Freshman year, first term, Chauvenet's Geometry, four exercises per week.

Second term, Olney's University Algebra, Plane and Spherical Trigonometry, including Mensuration and use of Logarithmic Tables, together five exercises per week throughout the term.

Sophomore year, first term, Olney's General Geometry and Davies' Analytical Geometry, four exercises per week.

Second term, Olney's Differential and Integral Calculus, four exercises per week. This term's work is elective for the Classical Course.

ASTRONOMY.—This study is taken up during the first term of the Senior year, Young's General Astronomy being used as the text-book. There are three exercises a week, and visits to the Observatory help to make the work interesting as well as profitable.

CHEMISTRY.—This study includes a complete course of lectures in Freshman year upon General Inorganic Chemistry, in which the principles of the science are fully covered. These are illustrated by experiments, and are sufficiently extended to enable a student who desires to pursue the subject further to take Analytical Chemistry as an elective in the second term of the Sophomore year. The text-book used in connection with the lectures is Fownes' Elementary Chemistry.

PHYSICS.—This important subject is presented in a course of lectures during the first term of the Sophomore year, three times a week. In the course in Science and Letters, the work in this branch is more extended and is identical with that given to the Civil and Mechanical Engineers. It

occupies five hours a week in the first term and three in the second, and covers the whole subject.

GEOLOGY.—In the second term of the Senior year, a course of lectures is given in connection with Geikie's text-book. The general principles of the science are explained, and the theories of the formation and stratification of rocks, the successive periods of the development of the earth's crust, the extinct forms of life and similar questions are treated.

PHYSIOLOGY AND HYGIENE.—These subjects are taught in a course of lectures during the Freshman year.

HISTORY, POLITICAL SCIENCE AND LAW.—The study of History begins with a course in the Political Antiquities of Greece and Rome. [See the Departments of Greek and Latin.] This is followed by the study of an outline of Universal History (with text-book), in which it is sought to give a clear view of the relations of ancient and modern states to the world's history. The same aim is then pursued in a fuller study of the Political History of Recent Times, and especially of that of England and France. During the first term of Senior year, there is a course of lectures upon the period covered by Gibbon's Decline and Fall of the Roman Empire, intended to emphasize and strengthen the impression of the interdependence of the nations and of the unity of history. This prepares the way for a course of lectures on the Philosophy of History, in which it is sought to show the relations of the sciences of Biology, Anthropology, Ethnology, Geography and Philology to the study of History and to set forth the scientific methods of that study.

The course in History is accompanied and supplemented by courses of lectures on Constitutional Law with special application to the Constitution of the United States; and also on International Law.

Instruction is given by lectures on the elements of Political Economy. The student is made familiar with the facts, methods and doctrines of the science, and is encouraged to form and present his own opinions.

LOGIC.—In this subject there is an elementary course, occupying two hours a week during the first term of Junior year. The work is done with the aid of a text-book, attention being centred on the principles of correct definition and valid proof.

MENTAL AND MORAL PHILOSOPHY.—The work in this department will be conducted chiefly by lectures, interrupted by occasional examinations. The courses at present are the following:

Outlines of Physiological Psychology.—Junior Class, second term. These lectures are founded principally on Wundt's lectures on the same subject, given in the University of Leipzig in the Summer of 1888, Wundt's Grundzüge der Physiologischen Psychologie, Ladd's Elements of Physiological Psychology, Sully's Outlines of Psychology, Carpenter's Mental Physiology, Maudsley's Physiology and Pathology of the Mind, Bain's Mind and Body, etc., with references to the works of Lotze, Weber, Fechner and Helmholtz.

The History of Philosophy.—Senior Class, both terms. First term, Ancient and Medieval Philosophy. Second term, Modern Philosophy. These lectures will include a statement of the conception and problems of Philosophy, a brief sketch of the great ethnical religions, and of the History of Oriental Philosophy. The Philosophy of the Greeks will be treated in detail, with illustrations from the writings of the philosophers.

The History of Medieval Philosophy will be prefaced by a short description of the philosophical ideas underlying Christianity, and it will contain an account of the more important Church Fathers and Schoolmen.

The History of Modern Philosophy will begin by tracing the effect on philosophical thought of the ideas contributed by the Renascence and by the Reformation. From Lord Bacon on, a detailed history of the great modern philosophical systems will be given, which will be continued to those of our own times, including Mr. Spencer.

CHRISTIAN EVIDENCES. — Senior Class, second term. Lectures on Christian Evidences, which will endeavor to treat of the subject both from the side of Natural Science and from that of Biblical Criticism.

No complete course in Ethics has as yet been established. But the History of Ethics is included in the History of Philosophy.

THE COURSE IN SCIENCE AND LETTERS

substitutes the following for the Latin and Greek.

DRAWING.—In the first term of the Freshman year the student is instructed in Elementary Projections, Shading and Lettering.

ZOÖLOGY AND BIOLOGY.— The study of these subjects covers one year, beginning with the second term of Sophomore year. The work begins with a description of the various animal functions, and is extended to the comparative anatomy and physiology of the organs in typical species. Systematic Zoölogy is then completed and followed by the theories of Biology.

CHEMISTRY. — In addition to the Course in General Chemistry described above, three exercises a week in Qualitative Analysis are taken in the second term of the Freshman year.

MINERALOGY.—Instruction in Mineralogy is given to the students in the Course in Science and Letters throughout the Junior year. In the first term, they attend a course of lectures on Crystallography, followed by a series of practical exercises in the determination of crystalline forms by the aid of models and natural crystals.

In the second term a course on the physical properties of minerals and on descriptive mineralogy, with the use of E. S. Dana's Text Book of Mineralogy, is followed by practical exercises in the determination of minerals.

GEOLOGY.—The study of Lithology is pursued in the first term of the Senior year, with laboratory practice, Williams' Lithology being used as the text-book. During the next term, the course given above is taken with the Classical and Latin-Scientific students.

THE CLASSICAL COURSE.

FRESHMAN CLASS.

FIRST TERM.

Mathematics.—Geometry (Chauvenet). (4)

Chemistry.—Lectures. Fownes' Elementary Chemistry. (4)

Greek.—Homer: Odyssey. Prosody. (3)

Latin.—Cicero: de Senectute and de Amicitia. Livy begun. Prose Composition. (2)

History.—History of Greece. (1)

Physiology and Health.—Lectures. (1)

English.—Rhetoric. Essays. (1)

Gymnasium. (2)

SECOND TERM.

Mathematics.—Olney's University Algebra, Pt. III. (3) Plane and Spherical Trigonometry and Mensuration. Use of Logarithmic Tables. (2)

Greek.—Xenophon: Œconomicus. (3)

Latin.—Livy completed. Horace: Odes and Epodes. Composition and Prosody. (4)

History.—History of Greece. (2) History of Rome. (1) Roman Antiquities.

English.—Rhetoric. Essays. (1)

Gymnasium. (2)

SOPHOMORE CLASS.

FIRST TERM.

Mathematics.—Analytical Geometry: Olney's General Geometry. (4)

Physics.—Lectures. (3)

French.—Whitney's Practical French Grammar. Keetel's Analytical Reader. (2) Or *German.*—Brandt's Grammar. Lodeman's Manual of Exercises. Joynes' Otto's Reader. (2)

Greek.—Herodotus and Thucydides. (2)

Latin.—Horace: Satires and Epistles. Composition. (2)

History.—History of Rome. (2) Antiquities.

English.—Rhetoric. Essays. (1)

Gymnasium. (2)

SECOND TERM.

French.—Grammar and Reader (continued). (2) Or *German.*—Grammar, Exercises and Reader (continued). (2)

English.—Coppée's Rhetoric, with Kellogg's Praxis. (1)

History.—Weber's Outlines of Universal History. (2)

Greek.—Euripides: Medea. (3)

Latin.—Tacitus: Agricola, Germania and Annals, or Quintilian: Book X. Composition. (3) Antiquities.

English.—Rhetoric. Essays. (1)

Gymnasium. (2)

In addition to the above exercises, four hours per week must be selected from the following elective studies:

Mathematics.—Differential and Integral Calculus: Olney. (4)

Greek.—Demosthenes: De Corona. (2)

Latin.—Plautus. (2)

French.—Grammar and Reader. (2)

German.—Grammar and Reader. (2)

Chemistry.—Qualitative Analysis—Laboratory. (2)

JUNIOR CLASS.

FIRST TERM.

History.—Wilhelm Müller's Political History of Recent Times, and Lectures. (2)

Philosophy.—Coppée's Logic. (2)

English.—Coppée's English Literature. (4)

French.—Grammar. Reading. (2) Or *German.*—Grammar. Reading. (2)

Greek.—Sophocles: Electra. Antiquities. (3)

Latin.—Letters of Cicero and Pliny. (3)

Essays and Original Orations.

Gymnasium. (2)

SECOND TERM.

History.—History of England: Hume. (3)

Philosophy.—Lectures on the Outlines of Physiological Psychology. (2) Political Economy. (1)

English.—Earl's Philology of the English Tongue. (2)

French. — O'Connor: Choix de Contes Contemporains. Sadler's Translator. Dictation. (2) Or *German.* — Buchheim's Prose Composition. Reading. Dictation. (2)

Greek.—Aristophanes: Clouds. Æschylus: Prometheus. (3)

Latin.—Persius and Terence. Cruttwell's History of Roman Literature. (3)

Literature and History. (1)

Essays and Original Orations.

Gymnasium. (2)

SENIOR CLASS.

FIRST TERM.

International Law.—Lectures: Woolsey. (2)

History.—Decline and Fall of the Roman Empire: Gibbon. (3)

Philosophy.—Lectures on the History of Ancient and Mediæval Philosophy. (2)

Astronomy.—Young's General Astronomy. (3)

French.—Sadler: Readings in Corneille, Racine, Molière, etc., and contemporary authors. Compositions. Lectures on French Literature. (2) Or *German.*—Grammar. Readings in Lessing, Herder, Goethe, Schiller, etc., and contemporary authors. Compositions. Lectures on German Literature. (2)

Conversation Class in both languages optional throughout the year.

Greek.—Plato: Phædrus. Greek Philosophy. (2)

Latin.—Lucretius, with Lectures. Roman Literature. (2)

Essays and Original Orations.

Gymnasium. (2)

SECOND TERM.

Constitutional Law.—Lectures. (1)

History.—History of France. (2)

Philosophy.—Lectures on the History of Modern Philosophy. (1) Philosophy of History. Lectures. (2)

Christian Evidences.—Lectures. (1)

French.—Readings. Compositions. Lectures in French on modern French authors. (2) Or *German.*—Readings. Compositions. Lectures in German on modern German authors. (2)

Geology.—Lectures. Geikie. (2)

Greek.—Pindar: Selected Odes. Greek Literature. (2)

Latin.—Cicero: de Officiis, with Lectures. (2)

Lectures on American and English Literature. (2)

Essays and Original Orations.

Preparation of Thesis.

Gymnasium.

THE LATIN-SCIENTIFIC COURSE.

The Latin-Scientific Course, leading to the degree of Bachelor of Science (B.S.), is based on Latin without Greek.

FRESHMAN CLASS.

FIRST TERM.

Mathematics.—Geometry (Chauvenet completed). (4)

Chemistry.—Lectures. Fownes' Elementary Chemistry. (4)

German.—Joynes-Meissner's Grammar. Joynes-Otto's Reader. (3)

Latin.—Cicero: De Senectute and De Amicitia. Livy begun. Prose Composition. (2)

History.—History of Greece. (1)

Physiology and Health.—Lectures. (1)

English.—Rhetoric. Essays. (1)

Gymnasium. (2)

SECOND TERM.

Mathematics.—Olney's University Algebra, Part III. (3) Plane and Spherical Trigonometry and Mensuration. Use of the Logarithmic Tables. (2)

German.—Grammar. Reader (continued). (3)

History.—History of Greece. (2) History of Rome. (1) Roman Antiquities.

Latin.—Livy (completed). Horace: Odes and Epodes. Composition and Prosody. (4)
English.—Rhetoric. Essays. (1)
Gymnasium. (2)

SOPHOMORE CLASS.

FIRST TERM.

Mathematics.—Analytical Geometry: Olney's General Geometry. (4)
Physics.—Lectures. (3)
French.—Whitney's Practical French Grammar. Super's Reader. (2)
German.—Harris's Prose Composition. Reading. (2)
History.—History of Rome. (2) Antiquities.
Latin.—Horace: Satires and Epistles. Composition. (2)
English.—Rhetoric. Essays. (1)
Gymnasium. (2)

SECOND TERM.

Mathematics.—Differential and Integral Calculus: Olney. (4)
English.—Coppée's Rhetoric, with Kellogg's Praxis. (1)
French.—Grammar. Reader (continued). (2)
German.—Harris. Reading. Dictation. (2)
History.—Weber's Outlines of Universal History. (2)
Latin.—Tacitus: Agricola, Germania and Annals, or Quintilian: Book X. Composition. (3) Antiquities.
English.—Rhetoric. Essays. (1)
Gymnasium. (2)

JUNIOR CLASS.

FIRST TERM.

History.—Wilhelm Müller's Political History of Recent Times, and Lectures. (2)
Philosophy.—Coppée's Logic. (2)
English.—Coppée's English Literature. (4)
French.—Grammar. Reading. (2)

German.—Readings in Lessing, Herder, Goethe, Schiller and contemporary authors. Dictation. Compositions. (2)

Conversation Class in German optional throughout the year.

Latin.—Letters of Cicero and Pliny. (3)

Essays and Original Orations.

Gymnasium. (2)

SECOND TERM.

History.—History of England: Hume. (3)

Philosophy.—Lectures on the Outlines of Physiological Psychology. (2) Political Economy. (1)

English.—Earle's Philology of the English Tongue. (2)

French.—O'Connor: Choix de Contes Contemporains. Sadler's Translator. Dictation. (2)

German.—Readings (continued). Dictation. Compositions. (2)

Latin.—Persius, Terence. Cruttwell's History of Roman Literature. (3)

Literature and History. (1)

Essays and Original Orations.

Gymnasium. (2)

SENIOR CLASS.

FIRST TERM.

International Law.—Lectures: Woolsey. (2)

History.—Decline and Fall of the Roman Empire: Gibbon. (3)

Philosophy.—Lectures on the History of Ancient and Medieval Philosophy. (2)

Astronomy.—Young's General Astronomy. (3)

French.—Readings in Corneille, Racine, Molière, etc., and contemporary authors. Lectures on French Literature. (2)

German.—Readings (continued). Compositions. Lectures on German Literature. (1)

Conversation Class in both languages optional throughout the year.

Latin.—Lucretius, with Lectures. Roman Literature. (2)

Essays and Original Orations.

Gymnasium.

SECOND TERM.

Constitutional Law.—Lectures. (1)

History.—History of France. (2)

Philosophy.—Lectures on the History of Modern Philosophy. (1) Philosophy of History. Lectures. (2)

Christian Evidences.—Lectures. (1)

Geology.—Lectures. Geikie. (2)

Latin.—Cicero: de Officiis, with Lectures. (2)

French.—Readings (continued). Compositions. Lectures in French on modern French authors. (2)

German.—Readings (continued). Compositions. Lectures in German on modern German authors. (1)

Lectures on American and English Literature. (2)

Essays and Original Orations.

Preparation of Thesis.

Gymnasium.

COURSE IN SCIENCE AND LETTERS.

The Course in Science and Letters, leading to the Degree of Bachelor of Science (B.S.), is designed for those who wish to pursue both Scientific and Literary studies without Latin and Greek. These being omitted, extended instruction is given in French and German, History, General Literature, Mathematics and General Science.

FRESHMAN CLASS.

FIRST TERM.

Mathematics.—Geometry (Chauvenet completed). (4)

Chemistry.—Lectures. Fownes' Elementary Chemistry. (4)

German.—Joynes-Meissner's Grammar. Joynes-Otto's Reader. (3)

Drawing.—Elementary Projections, Shading and Lettering. (2)

History.—History of Greece. (1)

Physiology and Health.—Lectures. (1)

English.—Rhetoric. Essays. (2)

Gymnasium. (2)

SECOND TERM.

Mathematics.—Olney's University Algebra, Part III. (3) Plane and Spherical Trigonometry and Mensuration. Use of the Logarithmic Tables. (2)

Chemistry.—Qualitative Analysis. (3)

History.—History of Greece. (2). History of Rome. (1)

German.—Grammar. Reader (continued). (3)

English.—Rhetoric. Essays. (2)

Gymnasium. (2)

SOPHOMORE CLASS.

FIRST TERM.

Mathematics.—Analytical Geometry: Olney's General Geometry. (4)

Physics.—Mechanics, Heat and Electricity. Lectures. (5)

French.—Whitney's Practical French Grammar. Super's Reader. (2)

German.—Harris's Prose Composition. Readings. (2)

History.—History of Rome. (2)

English.—Essays.

Gymnasium. (2)

SECOND TERM.

Mathematics.—Differential and Integral Calculus. Olney. (4)

Physics.—Sound, Light and Meteorology. Lectures. (3)

Zoölogy.—Lectures. Orton. (2)

English.—Coppée's Rhetoric, with Kellogg's Praxis. (1)

French.—Grammar. Readings (continued). (2)

German.—Harris. Readings. Dictation. (2)

History.—Weber's Outlines of Universal History. (2)

Essays.

Gymnasium. (2)

JUNIOR CLASS.

FIRST TERM.

History.—Wilhelm Müller's Political History of Recent Times, and Lectures. (2)

Philosophy.—Coppée's Logic. (4)

English.—Coppée's English Literature. (4)

French.—Grammar. Readings. (2)

German.—Readings in Lessing, Herder, Goethe, Schiller and contemporary authors. Dictation. Compositions. (2)

Conversation class in German optional throughout the year.

Zoölogy.—Lectures on Biology. (2)

Crystallography.—Lectures, with practical exercises in the determination of Crystals. (2)

Essays and Original Orations.

Gymnasium. (2)

SECOND TERM.

History.—History of England: Hume. (3)

Philosophy.—Lectures on the Outlines of Physiological Psychology. (2) Political Economy. (1)

English.—Earle's Philology of the English Tongue. (2)

French.—Grammar. O'Connor: Choix de Contes Contemporains. Sadler's Translator. Dictation. (2)

German.—Readings (continued). Compositions. (2)

Mineralogy.—Descriptive Mineralogy, with practical exercises in the determination of Minerals. (3)

Literature and History. (1)

Essays and Original Orations.

Gymnasium. (2)

SENIOR CLASS.

FIRST TERM.

International Law.—Lectures: Woolsey. (2)

History.—Decline and Fall of the Roman Empire. (3)

Philosophy.—Lectures on the History of Ancient and Medieval Philosophy. (2)

Astronomy.—Young's General Astronomy. (3)

French.—Readings in Corneille, Racine, Molière, etc., and contemporary authors. Compositions. Lectures on French Literature. (2)

German.—Readings (continued). Compositions. Lectures on German Literature. (1)

In both languages Conversation class optional throughout the year.

Geology. — Williams' Lithology and Laboratory Practice. (2)

Essays and Original Orations.

Gymnasium.

SECOND TERM.

Constitutional Law.—Lectures. (1)

History.—History of France. (2)

Philosophy.—Lectures on the History of Modern Philosophy. (1) Philosophy of History. Lectures. (2)

Christian Evidences.—Lectures. (1)

French.—Readings (continued). Compositions. Lectures in French on modern French authors. (1)

German.—Readings (continued). Compositions. Lectures in German on modern German authors. (1)

Geology. — Historic, Dynamic and Economic Geology. Geikie. (2)

Lectures on American and English Literature. (2)

Essays and Original Orations.

Preparation of Thesis.

Gymnasium.

THE SCHOOL OF TECHNOLOGY.

This school includes seven distinct courses:

I. The Course in Civil Engineering.
II. The Course in Mechanical Engineering.
III. The Course in Mining.
IV. The Course in Metallurgy.
V. The Course in Electrical Engineering.
VI. The Course in Chemistry.
VII. The Course in Architecture.

These have the same curriculum of studies for the first term of the Freshman year. At the end of that time the student selects his course and follows its program.

FRESHMAN CLASS.

FIRST TERM.

Mathematics.—Chauvenet's Geometry (completed). (4)

Chemistry.—Lectures. Fownes' Elementary Chemistry. (4)

French.—Whitney's Practical French Grammar. Super's Reader. (3) Or *German.*—Joynes-Meissner's Grammar. Joynes-Otto's Reader. (3)

Drawing.—Free-Hand Sketching and Lettering. (2)

English.—Rhetoric. Essays. (1)

Physiology and Health.—Lectures. (1)

Gymnasium. (2)

THE COURSE IN CIVIL ENGINEERING.

The special technical studies in this course may be grouped under the heads of Surveying, Applied Mechanics, Road and Railroad Construction, Bridge Design, and Hydraulic and Sanitary Engineering.

The work in Surveying extends over six terms and embraces land surveying, leveling, topography, triangulation, railroad reconnaissance and location, hydrography, and the elements of geodesy. A large equipment of transits, levels and other surveying tools affords students the opportunity of becoming familiar with the instruments of different manufacturers. Much time is devoted to practice in the field and drafting room, each student being required to become proficient in the use of instruments, in taking field notes and in map-drawing. Particular attention is paid to the execution of topographical surveys and maps by the best modern methods. During the Senior year there is done secondary triangulation work of a high order of precision.

The work in Applied Mechanics comprises the strength and elasticity of materials, the theory of the equilibrium of arches, roofs and bridges, that part of the mechanics of machinery which relates to locomotives and hoisting machines, and the theory of hydraulics and hydraulic motors. Here the theoretical principles are illustrated by examples and problems taken as far as possible from actual engineering practice and a special report is required from each

student on the testing machines of the Bethlehem Iron Company.

The course in Construction familiarizes the student with the qualities of materials used in engineering structures, with methods of preservation and testing, with masonry and foundations, and with the building and maintenance of roads and railroads. Plans, drawings and estimates of cost are prepared for the construction of a line of railroad, all details, such as drains, culverts, road crossings, etc., being worked out by each student.

The course in Bridge Design is preceded by the theory of computation of stresses by both analytical and graphic methods. Starting with the specifications for a first-class iron highway or railroad bridge, each student then makes the full computations, designs, working drawings and bills of material for a plate girder and for a pin-connected truss bridge. The weight of the designed bridge is finally determined and compared with the dead load assumed for the calculations. The drawings are made and dimensioned in the same manner as in the drafting office of a bridge company. In connection with this course visits of inspection to bridges in the vicinity are regularly made.

The work in Hydraulic and Sanitary Engineering embraces the study of systems of water supply, the collection, purification and distribution of water, the combined and the separate systems of sewerage, the methods for the disposal of sewage, and the best practice for the drainage and ventilation of houses. The hydraulic laboratory in the University Park affords opportunity for experiments on the actual measurement of water by means of weirs and orifices, and the testing of hydraulic motors.

Besides these special studies there is a course in Astronomy, which includes practical work in the Observatory. The study of English, and of French or German, is continued, and instruction is given during four terms in Crystallography, Mineralogy, Lithology and Geology.

The student who completes all the studies of this course will receive the degree of Civil Engineer (C.E).

FRESHMAN CLASS.

FIRST TERM.

See page 59.

SECOND TERM.

Mathematics.—Olney's University Algebra, Part III. (3) Plane and Spherical Trigonometry and Mensuration. Use of Logarithmic Tables. (2)

Surveying.—Theory of Chain and Compass Surveying. Computation of Areas. Elements of Leveling. (1)

French.—Grammar and Reader (continued). (3) Or *German.*—Grammar and Reader (continued). (3)

Drawing.—Descriptive Geometry and Isometric Drawing. Tracings. Warren's Elementary Projection Drawing. (4)

English.—Rhetoric. Essays. (2)

Gymnasium. (2)

SOPHOMORE CLASS.

FIRST TERM.

Mathematics.—Analytical Geometry: Olney's General Geometry. (4)

Physics.—Mechanics, Heat and Electricity. Lectures. (5)

French.—Grammar. Reading. (2) Or *German.*—Grammar. Reading. (2)

Drawing.—Isometric Drawing. Architectural Drawing. (2)

Surveying.—Use of Compass, Level and Transit. Surveys and Maps of Farms. Colored Topography. (2).

English.—Essays.

Gymnasium. (2)

SECOND TERM.

Mathematics.—Differential and Integral Calculus: Olney and Courtenay. (4)

Physics.—Sound, Light and Meteorology. Lectures. (3)

French.—Grammar. O'Connor: Choix de Contes Contemporains. Dictation. (2) Or *German.*—Grammar. Reading. Dictation. (2)

Mechanics.—Theory of motion, statics, energy, center of gravity, moment of inertia and general equations of motion. (4)

Surveying.—Profiles and Contour Maps. Hydrographic and City Surveying. Use of the Plane Table. Topographical Drawing. (3)

English.—Essays.

Gymnasium. (2)

JUNIOR CLASS.

FIRST TERM.

Mathematics.—Courtenay's Calculus, and Wood's Analytical Mechanics. (2)

French.—Readings. Dictation. Compositions. (2) Or *German.*—Readings. Dictation. Compositions. (2)

Conversation Class in both languages optional throughout the year.

Surveying.—Triangulation. Leveling. Topographical Surveying with Transit and Stadia. Topographical Map. (4)

Strength of Materials.—Elasticity and Strength of Wood, Stone and Metals. Theory of Columns, Shafts and Beams. Reports on the Testing of Materials. (4)

Construction.—Materials of Construction. Masonry. Foundations. Theory of retaining walls and stone arches. (2)

Crystallography.—Lectures, with practical exercises in the determination of crystals. (2)

Essays and Original Orations.

Gymnasium. (2)

SECOND TERM.

French.—Readings. Compositions. Lectures on French Literature. (2) Or *German.*—Readings. Compositions. Lectures on German Literature. (2)

Surveying.—Theory of Railroad Curves. Railroad Reconnaissance and Location. Survey of a Line, with Profile, Map and Estimate of Cost. (4)

Roofs and Bridges.—Theory and Calculations of Strains in Roof and Bridge Trusses. Graphic Statics. (3)

Construction.—Stone Cutting, with practical Drawings. (3) Construction and Maintenance of Roads and Railroads. (1)

Mineralogy.—Descriptive Mineralogy, with practical exercises in the determination of minerals. (3)

Literature and History. (1)

Gymnasium. (2)

SENIOR CLASS

FIRST TERM.

Astronomy.—Young's General Astronomy. (3)

Bridges.—Suspension, Continuous and Cantilever Bridges. Design of Plate Girders and Riveted Bridges, with Working Drawings. (6)

Surveying.—Use of Solar Transit and Sextant. Precise Triangulation. Elements of Geodesy. The Figure of the Earth. (3)

Mechanics of Machinery.—Pile Drivers, Cranes and Elevators. The mechanics of the Locomotive. (2)

Geology.—Williams' Lithology, with practical exercises in determining rocks. (2)

Gymnasium.

SECOND TERM.

Astronomy.—Doolittle's Practical Astronomy, with observatory work. (2)

Bridges.—Design of Pin-Connected Bridges, with working drawings. (3)

Hydraulics.—Hydrostatics. Efflux of Water from Orifices and Flow in Pipes and Rivers. Hydraulic Motors. (2)

Hydraulic and Sanitary Engineering.—Collection, Purification and Distribution of Water. Systems of Water Supply. The Combined and the Separate System of Sewerage. Disposal of Sewage. House Drainage. Hydraulic Experiments. (4)

Geology.—Historic and Dynamic. Geikie. (2)

Lectures on American and English Literature. (2)

Christian Evidences.—Lectures. (1)

Preparation of Thesis.

Gymnasium.

THE COURSE IN MECHANICAL ENGINEERING.

The object of this course is the study of the Science of Machines. The principal subjects taught are: The nature, equivalence and analysis of mechanisms, the mechanics or theory of the principal classes or types of machinery, Mechanical Technology and the principles and practice of Machine Design.

That the students may obtain the practical engineering data which they will most need when beginning their work as mechanical engineers they are required to pursue a course of Shop Instruction which does not necessarily involve manual labor and manipulation of tools, but is principally devoted to familiarizing them with those points in pattern-making, moulding, forging, fitting and finishing, which they need to know as designers of machinery. Particular attention is therefore directed to the forms and sizes of machine parts that can be readily constructed in the various workshops, to the time that it takes to perform, and the order of, the various operations, to the dimensions most needed by workmen and to the various devices for increasing the accuracy of the work, durability of the parts and convenience of manipulation. This involves acquaintance with the processes and machinery of the workshops, but it is the foreman's and superintendent's knowledge which is required rather than the manual dexterity and skill of the workman and tool-hand. The acquirements peculiar to the latter are by no means despised and the students are encouraged to familiarize themselves therewith during leisure hours, but manual work in the shops forms no regular part of the course. On the contrary, the student enters the shop with hands and mind free to examine all processes, operations and machinery, and is ready at the call of the teacher to witness any operation of special interest. Provided with note-book, pencil, calipers and measuring rule, the student sketches the most important parts of the various machine-tools, notes down the successive steps of each of the important shop-processes as illustrated by the pieces operated upon, and follows the

pieces of work through the shops from the pig or merchant form to the finished machine.

That the students may learn to observe carefully and be trained to think and observe for themselves in these matters, there is required of them a full description of the various processes, operations and tools involved in the production of each one of a series of properly graded examples of patterns, castings, forgings and finished pieces which are not being constructed in the shops at the time and the blue prints for which have been given to them on entering the shops. The student's work is directed not only by these drawings and by the printed program given him at the start, but also personally by a teacher, who accompanies him into the shops, gives necessary explanations, and tests the extent and accuracy of his knowledge by examining the sketches and notes and by frequent questioning. Finally the results of the observations and the sketches are embodied in a memoir.

During the course there are frequent visits of inspection to the Bethlehem Iron Company, the L. V. R. R. Shops at Easton, and other engineering works both in and out of town, with special reference to such subjects as Machine Elements, Prime Movers, Machinery for lifting, handling and transporting, and Machinery for changing the form and size of materials. It is intended that each of these excursions shall have some definite purpose in view which must be fully reported by the students. These visits are also made the occasion for constant practice in the Free-Hand Sketching of Machinery.

The instruction in Machine Design begins with second term of the Freshman year and is continued throughout the course. At first tracings and blue prints of good examples of machine drawings are made. A thorough drill in projection drawing follows; in this work free-hand sketches are first made, and measurements taken, of machine pieces; these sketches are then converted into full-size working drawings. Then there is considerable practice in the interpretation of such drawings, and general views of

lathes, planers, drills and shapers are made from the drawings of the details. This is followed by difficult projections and intersections and exercises in the empirical proportioning of machine parts. Both empirical and rational formulas are used to determine the dimensions of fastenings, bearings, rotating and sliding pieces, belt and toothed gearing, levers and connecting rods, the data being given as they would arise in practice and the drawings made full size. During the Junior year the class takes up the design of a high-speed steam engine, every dimension being determined by the students and complete drawings made. During the Senior year the students undertake the calculations, estimates and working drawings involved in the design of a simple but complete machine, each student being engaged upon a different machine. From the finished drawings of each machine tracings are made and then blue prints taken for distribution among the other members of the class. In the case of the machines and of the engine the general plan or arrangement will be given to the students in the form of rough sketches, photographs or woodcuts. In the last term the students are expected to make original designs for simple machinery, whose object has been fully explained. Throughout the course the work in the draughting-room is carried on as nearly as possible like that of an engineering establishment, and special attention is paid to methods of expediting the work of calculation by means of simple formulas, tables and diagrams.

The graduates in this course will receive the degree of Mechanical Engineer (M.E.).

FRESHMAN CLASS.

FIRST TERM.

See page 59.

SECOND TERM.

Mathematics.—Olney's University Algebra, Part III. (3) Plane and Spherical Trigonometry and Mensuration. Use of Logarithmic Tables. (2)

French.—Grammar and Reader (continued). (3) Or *German.*—Grammar and Reader (continued). (3)

Drawing and Machine Design.—Tracings and blue prints. Sketches and working drawings of machine pieces. Interpretation of machine drawing by isometric sketches. General views from given details. Sections of stub ends and valve passages. Intersection of boiler flues. Empirical proportioning of machine parts. (5)

English.—Rhetoric. Essays. (2)

Gymnasium. (2)

SOPHOMORE CLASS.

FIRST TERM.

Mathematics.—Analytical Geometry: Olney's General Geometry. (4)

Physics.—Mechanics, Heat and Electricity. Lectures. (5)

Machine Design.—Proportioning of such machine parts as come under the head of fastenings, bearings, rotating and sliding pieces, belt and toothed gearing, levers and connecting rods. (2)

Visits of Inspection.—Examination and sketching of principal machine parts in the shops of the vicinity. (2)

French.—Grammar. Reading. (2) Or *German.*—Grammar. Reading. (2)

English.—Essays.

Gymnasium. (2)

SECOND TERM.

Mathematics.—Differential and Integral Calculus: Olney and Courtenay. (4)

Physics.—Sound, Light and Meteorology. Lectures. (3)

French.—Grammar. O'Connor: Choix de Contes Contemporains. Dictation. (2) Or *German.*—Grammar. Reading. Dictation. (2)

Mechanics.—Theory of motion, statics, energy, center of gravity, moment of inertia and general equations of motion. (4)

Steam Engine.—Holmes' Steam Engine. (3)
English.—Essays.
Gymnasium. (2)

JUNIOR CLASS.

FIRST TERM.

Mathematics.—Courtenay's Calculus and Wood's Analytical Mechanics. (2)

French.—Readings. Dictation. Compositions. (2) Or *German.*—Readings. Dictation. Compositions. (2)

Conversation class in both languages optional throughout the year.

Mechanical Technology.—Shop instruction. Examination of the processes and appliances involved in pattern-making, moulding, forging, fitting and finishing, with sketches and reports. (7)

Boilers.—Wilson. Strength, construction and wear and tear of boilers. (1)

Strength of Materials.—Elasticity and strength of wood, stone and metals. Theory of beams, shafts and columns. Reports on experimental tests. (4)

Essays and Original Orations.
Gymnasium. (2)

SECOND TERM.

French.—Readings. Compositions. Lectures on French Literature. (2) Or *German.*—Readings. Compositions. Lectures on German Literature. (2)

Kinematics of Machinery.—Reuleaux. Nature and Equivalence of Mechanisms. (3)

Machine Design.—Calculations and Working Drawings for a High-Speed Steam Engine. (5)

Metallurgy.—Metallurgical Processes. Furnaces. Refractory Building Materials. Combustion. Natural and Artificial Fuels. Metallurgy of Iron. (4)

Machinery of Transmission.—Weisbach-Herrmann. (2)
Literature and History. (1)
Gymnasium. (2)

SENIOR CLASS.

FIRST TERM.

Thermodynamics. — General principles; application to Steam Engines and Air Compressors. (3)

Graphical Statics.—Graphical Analysis of Roof Trusses and Girders. (2)

Machine Design.—Calculations and Working Drawings for hoisting, pumping and metal-working machinery. (4)

Kinematics.—Diagrams of the changes of position, speed and acceleration in mechanisms. Link and Valve motions. Quick return motions. Parallel motions. Laying out of Cams. (3)

Mechanics of Machinery.—Weisbach-Herrmann. Hoisting machinery, accumulators, cranes and locomotives. (4)

Gymnasium.

SECOND TERM.

Mechanics of Machinery.—Weisbach-Herrmann. Pumps, pumping engines, blowing engines, compressors and fans. (4)

Machine Design.—Original Designs. (5)

Hydraulics.—Hydrostatics. Flow of water in pipes and channels; hydraulic motors. (2)

Measurement of Power.—Indicating of Steam Engines; determination of evaporative efficiency of boilers; dynamometer experiments. (1)

Lectures on American and English Literature. (2)

Christian Evidences.—Lectures. (1)

Preparation of Thesis.

Gymnasium.

THE COURSES IN MINING AND METALLURGY.

These courses aim to fit the student for practical work in either of the branches of mining, metallurgy, metallurgical chemistry or geology. On account of the great number and scope of the studies necessary to the attainment of the degree of Engineer of Mines (E.M.), which includes that of Metallurgist, five years are required. At the end of the fourth year the student will have completed a course similar to that leading to the scientific degree in other institutions, and will receive the degree of Bachelor of Science (B.S.). At the end of the Freshman year an opportunity is given the student to select one of two courses leading to the above degrees. These allow a full course in either mining or metallurgy to be acquired in four years, and afford to the student whose time is limited and who desires to practice one of the above branches the means for rapid work. The graduate in either course can obtain the Engineer's degree (E.M.) by one year of post-graduate work. The following program of subjects and studies shows the requirements for the degree of Engineer of Mines.

Modern Languages.—Although the option of studying French or German lies with the student, it may be well to note that the current literature of the subjects taught in these courses is more abundant in the latter language.

Drawing and Construction.—The course in machine design begins in the second term of Freshman year with tracings of good examples of machine drawings; then follow the interpretation of such drawings, and the making of general views of machines from detailed sketches; exercises in projection drawing from the same, and the proportioning of simple tools and machines. In Sophomore year the metallurgist becomes acquainted with the arrangement and details of metallurgical plant and in Senior year he designs the same. The post-graduate, during the entire year, becomes acquainted with and designs mining plant. The field work in mining and geological surveying is followed by map construction from field notes. Practice in

mining and metallurgical construction is also afforded by the projects.

CHEMISTRY. — The course in theoretical and applied chemistry extends over three years and includes work in wet and dry assaying of all the important ores and metallurgical products met with in actual practice, combined with the working of stoichiometric problems and the study of chemical philosophy. The practical work is that required for a metallurgical chemist or assayer.

With moderate care the expenses in this department need not exceed $120.

MINERALOGY.—This subject is divided into two courses. In the first course, after a short exposition of the laws of crystallography and a description of crystalline forms, practical exercises are held in the determination of simple and complex crystals, in which the student is taught to identify the various crystalline forms observed in minerals by the aid of models and of actual crystals, and with the use of the application goniometer. The second course includes the subjects of physical, descriptive and determinative mineralogy. As in the first course, the greater part of the time is devoted to practical exercises which, in this course, have for their object the determination of minerals. Each student is thus enabled to become familiar with the more common minerals by the actual handling of several hundred specimens, with the facility of making such tests as will not injure them. The presence of one or more instructors during each exercise permits the student to make frequent reports of his determinations, and to receive much instruction as to the characteristics of the minerals. The knowledge thus acquired can be supplemented by visits to the museum.

The course in blowpipe analysis may be considered as auxiliary to the practical exercises in determinative mineralogy. In the latter the student is urged to rely chiefly on physical tests; in the former he is required to determine minerals by the aid of the blowpipe.

The mineralogical laboratory offers facilities for an advanced course in crystallography and in physical and microscopic mineralogy to a few students who may receive permission to pursue such a course.

GEOLOGY.—This subject is studied with special reference to the needs of the mining engineer. Within a radius of twenty miles the student meets and becomes acquainted with the rocks of the archæan, the palæozoic and mesozoic formations, and makes geological maps from his own field notes, paying attention to the lithological characters of the formations, as they are mainly non-fossiliferous. An extended practical course in lithology familiarizes the student with the rocks of importance to the mining engineer and enables him to determine them by sight. There are over 2000 specimens in the collection, embracing all the known species. The course in historic geology is illustrated by a cabinet of typical specimens. The course in economic geology supplements the above work by familiarizing the student with the geological horizon of all the valuable constituents of the earth's crust and the theories of their formation.

ASTRONOMY.—After studying the theory of the subject two thirds of the year are devoted to practical work in the observatory.

APPLIED MECHANICS.—This embraces hydraulics, a study of the steam engine and the mechanics of machines employed in mining and metallurgy.

SURVEYING.—A course extending over five terms offers practice in land, mine and geological surveying, leveling, topography, triangulation and railroad reconnaissance and location. It also includes practical work in drawing and map construction.

METALLURGY.—There are two courses of, together, about one hundred and forty lectures upon this subject, which extend throughout a year. In these the chief object kept in view is a clear presentation of the principles involved in the various metallurgical processes, looked upon as the

application to practice of the laws of chemistry, physics and mechanics. This is followed, in the case of each process, by a description of the more important examples of the plant and of the methods of conducting the process, and by indications concerning its economic features. In order to ensure that the student shall understand the fundamental principles of metallurgy, and shall become so familiar with them as to be able readily to apply them, he is required to solve a series of problems in which these principles are involved. Many of the problems are such as are likely to present themselves to the metallurgist in his current practice.

The metallurgical laboratory affords opportunity for special investigations in subjects connected with metallurgy to such advanced students as are competent to conduct them.

MINING.—This subject is covered by three courses. The first begins with the application of economic geology to the needs of the engineer, so that he can study and value mining properties, locate appropriately the necessary plant, and calculate the cost of production. It includes the discussion of faults and the means of finding faulted bodies, with practical problems. The subjects of blasting, timbering and winning deposits are applied to actual cases, as tunnel-driving, etc., and problems from practical data are solved by the students. The second course covers the subjects of underground and surface haulage; loading, unloading and stocking ores; pumping; ventilation; hygiene and mining law. A series of problems is given in each of these subjects to cover cases that meet the engineer in ordinary practice. The third course treats of the mechanical preparation of ores by the wet, dry, or magnetic methods, and especially of the preparation of anthracite coal.

The location of the University in the vicinity of the iron works of the Lehigh Valley, and especially of the extensive establishment of the Bethlehem Iron Company, affords unusual facilities for the practical study of iron metallurgy. The processes for the manufacture of spelter and oxide of

zinc may be studied at the Bethlehem Zinc Works. The facilities for the practical study of mining and economic geology are not excelled by those of any other institution in the country. The zinc mines at Friedensville, the paint ores of the Marcellus formation, and the brown hematite and slate deposits of the Lehigh Valley are in the immediate vicinity, while within easy reach by rail are the semi-bituminous and anthracite coal fields, the block and fossil iron ores of the Clinton measures, the iron mines at Cornwall, Pennsylvania, and the iron and zinc mines of New Jersey; together affording examples of nearly all the methods of winning and dressing valuable deposits. Numerous visits of inspection are made in connection with the work of the course, to familiarize the student with metallurgical and mining processes and afford data for practical examples and projects.

FRESHMAN CLASS.

FIRST TERM.

See page 59.

SECOND TERM.

Mathematics.—Olney's University Algebra, Part III. (3) Plane and Spherical Trigonometry and Mensuration. Use of Logarithmic Tables. (2)

French.—Grammar and Reader (continued). (3) *German.*—Grammar and Reader (continued). (3)

Machine and Mining Drawing.—Tracings and blue prints. Sketches and working drawings of machine pieces. Interpretation of machine drawings by isometric sketches. General views from given details. Sections of stub-ends and valve passages. Intersection of boiler-flues. Empirical proportioning of machine parts. Graphical problems illustrating the direction and extent of throw in faults. (5)

Surveying.—Theory of chain and compass surveying. Computation of areas. Elements of leveling. (1)

English.—Rhetoric. Essays. (2)

Gymnasium. (2)

THE COURSE IN METALLURGY.

This course is arranged so that the subjects which prepare the student for practice in the field of metallurgy shall be completed at the end of four years, when the graduate will receive the degree of Bachelor of Science in Metallurgy (B.S.). By remaining a year longer, and taking the subjects laid down for the post-graduate year, the graduate in the course may obtain the degree of Engineer of Mines (E.M.).

SOPHOMORE CLASS.

FIRST TERM.

Mathematics.—Analytical Geometry: Olney's General Geometry. (4)

Physics.—Mechanics, Heat and Electricity. Lectures. (5)

French.—Grammar. Reading. (2) Or *German.*—Grammar. Reading. (2)

Drawing.—General views of metallurgical plant and detailed sketches. (2)

Surveying.—Use of the Level and Transit. Surveys and maps of farms. Colored topography. (2)

English.—Essays.

Gymnasium. (2)

SECOND TERM.

Mathematics.—Differential and Integral Calculus: Olney and Courtenay. (4)

Mechanics.—Theory of motion, statics, energy, center of gravity, moment of inertia and general equations of motion. (4)

Chemistry.—Lectures and laboratory practice. Douglass and Prescott's Qualitative Analysis. (4)

Stoichiometry. (2)

French.—Grammar. O'Connor: Choix de Contes Contemporains. Dictation. (2) Or *German.*—Grammar. Reading. Dictation. (2)

English.—Essays.

Gymnasium. (2)

JUNIOR CLASS.

FIRST TERM.

Mathematics.—Courtenay's Calculus and Wood's Analytical Mechanics. (2)

Strength of Materials.—Elasticity and strength of wood, stone and metals. Theory of beams, columns and shafts. (4)

Crystallography.—Lectures, with practical exercises in the determination of crystals. (2)

Assaying.—Including the assay by the dry methods of Gold, Silver, Antimony, Mercury, Lead, Iron and Tin ores. Laboratory work. Ricketts. (3)

Chemical Philosophy.—Cooke. (3)

French.—Readings. Dictation. Compositions. (2) Or *German.*—Readings. Dictation. Compositions. (2)

Conversation class in both languages optional throughout the year.

Essays and Original Orations.

Gymnasium. (2)

SECOND TERM.

Metallurgy.—Metallurgical Processes. Furnaces. Refractory building materials. Combustion. Natural and artificial fuels. Metallurgy of Iron. (4)

Mineralogy.—Descriptive Mineralogy, with practical exercises in the determination of minerals: E. S. Dana. (3)

Blow-Pipe Analysis.—Lectures, with practice. Plattner, Brush, or Nason and Chandler. (1)

Chemistry.—Fresenius' Quantitative Analysis. (4) The following analyses are executed by the student:

1. Iron Wire (Fe)
2. Copper Ore (Cu)
3. Silver Coin (Au, Ag, Pb, Cu)
4. Zinc Ore (Zn) By both Gravimetric and Volumetric Methods.
5. Bronze (Cu, Sn, Zn, Pb)
6. Spiegeleisen (Mn)
7. Lead Ore (PbS)
8. Ilmenite (TiO_2)

9. Iron Ore (complete analysis)
10. Limestone (complete analysis)
11. Coal (Volatile Matter, Fixed Carbon, Ash, H_2O, S, P)

Steam Engine.—Holmes' Steam Engine. (3)

French.—Readings. Compositions. Lectures on French Literature. (2) Or *German.*—Readings. Compositions. Lectures on German Literature. (2)

Literature and History.

Gymnasium. (2)

SENIOR CLASS.

FIRST TERM.

Metallurgy.—Of Copper, Lead, Silver, Gold, Platinum, Mercury, Tin, Zinc, Nickel, Cobalt, Arsenic, Antimony and Bismuth. (5)

Blow-Pipe Analysis.—Practice. (1)

Lithology.—Williams' Lithology, with practical exercises in determining rocks. (3)

Mechanics of Machinery.—Weisbach-Herrmann. Hoisting machinery, accumulators, cranes. (2)

Chemistry.—Quantitative Analysis: Laboratory Work: Fresenius. (3) The following analyses are executed by the student:

12. Slag (complete analysis)
13. Pig Iron (complete analysis)
14. Carbon in Steel (Volumetric)
15. Nickel Ore (Ni, Co)
16. Gas Analysis.

Graphical Statics.—Graphical analysis of roof trusses and girders. (2)

Projects.—In Metallurgy. (1)

Gymnasium.

SECOND TERM.

Mining.—Mechanical Preparation of Ores. Coal Washing. Callon. Lectures. (2)

Geology.—Economic Geology. Lectures. Williams. (2)

Drawing.—Designing of furnaces and other metallurgical plant. (2)

Mechanics of Machinery.—Pumps, pumping-engines, blowing-engines, compressors and fans. (4)

Hydraulics.—Hydrostatics. Flow of water in pipes and channels. Hydraulic motors. (2)

Lectures on American and English Literature. (2)

Christian Evidences.—Lectures. (1)

Preparation of Thesis.

Gymnasium.

POST-GRADUATE YEAR.

FIRST TERM.

Mining.—Modes of occurrence of the useful minerals. Searching for mineral deposits. Examination of mining properties. Boring. Mining tools, machines and processes. Timbering and masonry. Methods of working. Callon, André. Lectures. (3)

Geology.—General geological definitions and principles. Dynamic geology. Dana. (2)

Drawing.—General views of mining plant and detailed sketches. (2)

Projects.—In geology and mining. (1)

Surveying.—Mine survey. Theory and practice, with construction of mine maps. Tunneling and shaft location. (2)

Astronomy.—Descriptive astronomy: Loomis. (3)

Surveying.—Triangulation. Leveling. Topographical surveys with transit and stadia. Topographical maps. (4)

SECOND TERM.

Mining.—Underground transportation. Hoisting, drainage and pumping. Ventilation and Lighting. Hygiene of mines. Mining law. (3)

Geology.—Historic geology. Dana. (2)

Surveying.—Geological survey: mapping and cross-sectioning. (2)

Drawing.—Designing of mining plant. (2)

Surveying.—Theory of railroad curves. Railroad reconnaissance and location. Survey of a line, with profile, map and estimate of cost. (4)

Astronomy.—Doolittle's Practical Astronomy, with observatory work. (2)

Preparation of Thesis.

THE COURSE IN MINING.

This course is designed so that the student who desires to pursue the practice of mining and ore-dressing, and who does not wish to take the full course, may be prepared for practice in four years, receiving the degree of Bachelor of Science in Mining (B.S.). By remaining a year longer, and taking the subjects laid down for the post-graduate year, the graduate in this course may obtain the degree of Engineer of Mines (E.M.).

This course is identical with the preceding up to the end of the Freshman year.

SOPHOMORE CLASS.

FIRST TERM.

Mathematics.—Analytical Geometry: Olney's General Geometry. (4)

Physics.—Mechanics, Heat and Electricity. Lectures. (5)

French.—Grammar. Reading. (2) Or *German.*—Grammar. Reading. (2)

Crystallography.—Lectures, with practical exercises in the determination of crystals. (2)

Surveying.—Use of the level and transit. Surveys and maps of farms. Colored topography. (2)

English.—Essays.

Gymnasium. (2)

SECOND TERM.

Mathematics.—Differential and Integral Calculus: Olney and Courtenay. (4)

Mechanics.—Theory of motion, statics, energy, center of gravity, moment of inertia and general equations of motion. (4)

Chemistry.—Lectures and laboratory practice. Douglass and Prescott's Qualitative Analysis. (4)

Mineralogy.—Descriptive mineralogy, with practical exercises in the determination of minerals: E. S. Dana. (3)

French.—Grammar. O'Connor: Choix de Contes Contemporains. Dictation. (2) Or *German.*—Grammar. Reading. Dictation. (2)

English.—Essays.

Gymnasium. (2)

JUNIOR CLASS.

FIRST TERM.

Mathematics.—Courtenay's Calculus and Wood's Analytical Mechanics. (2)

Strength of Materials.—Elasticity and strength of wood, stone and metals. Theory of beams, columns and shafts. (4)

Geology.—General geological definitions and principles. Dynamic geology. Dana. (2)

Lithology.—Williams' Lithology, with practical exercises in determining rocks. (3)

Surveying.—Triangulation. Leveling. Topographical surveys with transit and stadia. Topographical maps. (4)

French.—Readings. Dictation. Compositions. (2) Or *German.*—Readings. Dictation. Compositions. (2)

Conversation class in both languages optional throughout the year.

English.—Essays.

Gymnasium. (2)

SECOND TERM.

Geology. — Historic and Economic Geology. Lectures. Dana. (4)

Blow-Pipe Analysis.—Lectures, with practice. Plattner, Brush, or Nason and Chandler. (1)

Surveying.—Geological survey: mapping and cross-sectioning. (2)

Steam Engine.—Holmes' Steam Engine. (3)

Surveying.—Theory of railroad curves. Railroad reconnaissance and location. Survey of a line, with profile, map and estimate of cost. (4)

French.—Readings. Compositions. Lectures on French Literature. (2) Or *German.*—Readings. Compositions. Lectures on German Literature. (2)

Literature and History.

Gymnasium. (2)

SENIOR CLASS.

FIRST TERM.

Mining.—Modes of occurrence of the useful minerals. Searching for mineral deposits. Examination of mining properties. Boring. Mining tools, machines and processes. Timbering and masonry. Methods of working. Callon. André. Lectures. (3)

Mechanics of Machinery. — Weisbach-Herrman. Hoisting machinery, accumulators, cranes. (2)

Astronomy.—Young's General Astronomy. (3)

Surveying.—Mine survey. Theory and practice, with construction of mine maps. Tunneling and shaft location. (2)

Assaying.—Including the assay by the dry methods of Gold, Silver, Antimony, Mercury, Lead, Iron and Tin ores. Laboratory Work, Ricketts. (3)

Drawing.—General views of mining plant and detailed sketches. (2)

Projects.—In Geology and Mining. (1)

Gymnasium.

SECOND TERM.

Mining.—Underground transportation. Hoisting, drainage and pumping. Ventilation and lighting. Hygiene of mines. Mining law. (3) Mechanical preparation of ores. Coal washing. (2)

Drawing.—Designing of mining plant. (2)

Mechanics of Machinery.—Pumps, pumping-engines, blowing-engines, compressors and fans. (4)

Hydraulics.—Hydrostatics. Flow of water in pipes and channels. Hydraulic motors. (2)

Lectures on American and English Literature. (2)

Christian Evidences.—Lectures. (1)

Preparation of Thesis.

Gymnasium.

POST-GRADUATE YEAR.

FIRST TERM.

Metallurgy.—Of Copper, Lead, Silver, Gold, Platinum, Mercury, Zinc, etc. (5)

Blow-Pipe Analysis.—Practice. (1)

Chemistry.—Qualitative Analysis: Laboratory Work: Fresenius. (3) The following analyses are executed by the student:

1. Iron Wire (Fe)
2. Copper Ore (Cu)
3. Silver Coin (Au, Ag, Pb, Cu)
4. Zinc Ore (Zn) By both Volumetric and Gravimetric methods.
5. Bronze (Cu, Sn, Zn, Pb)
6. Spiegeleisen (Mn)
7. Lead Ore (PbS)

Chemical Philosophy.—Cooke. (3)

Drawing.—General views of metallurgical plant and detailed sketches. (2)

Graphical Statics.—Graphical analysis of roof-trusses and girders. (2)

SECOND TERM.

Metallurgy.—Metallurgical Processes. Furnaces. Refractory building materials. Combustion. Natural and artificial fuels. Metallurgy of Iron. (4)

Chemistry.—Fresenius' Quantitative Analysis. (4) The following analyses are executed by the student:

8. Ilmenite (TiO_2)
9. Iron Ore (complete analysis)
10. Limestone (complete analysis)
11. Coal (Volatile Matter, Fixed Carbon, Ash, H_2O, S, P)
12. Slag (complete analysis)
13. Pig Iron (complete analysis)
14. Carbon in Steel (Volumetric)
15. Nickel Ore (Ni, Co)
16. Gas Analysis.

Stoichiometry. (2)

Drawing.—Designing of furnaces and other metallurgical plant. (2)

Projects.—In Metallurgy. (1)

Astronomy.—Doolittle's Practical Astronomy, with observatory work. (2)

Preparation of Thesis.

THE COURSE IN PHYSICS AND ELECTRICAL ENGINEERING.

In the arrangement of the details of this new course the object has been to provide for those who seek to fit themselves as Electrical Engineers a preliminary training as complete and broad as that given to the members of the other schools. The requirements for admission, the mathematical and English studies, the modern languages and other outside branches are the same as those in the other technical courses. To these have been added such portions of the Mechanical Engineering Course, with which this course is most closely allied, as are necessary to give the student a general but sufficiently accurate knowledge of machinery.

This preparation joined to the unusually full development of Physics—and especially of Electricity—will, it is thought, make a course sufficiently comprehensive and thorough for the proper training of candidates for this degree. The great success attending the large majority of the young men who have taken the one year's course in Electricity, in their subsequent electrical work, warrants the belief that this broader and more extended course will attain its object.

The main feature of this new course is the prominence given to the subject of Physics. This extends through three years, and while Electricity is specially developed the other branches, Elementary Mechanics, Heat and Light, are fully provided for. The opportunity is thus given to any one who wishes to acquire a more extensive knowledge of Physics than the University curriculum has heretofore offered. The student is well drilled in the theory by means of lectures and recitations, which carefully cover the whole subject, and he is required to go over the ground himself in the best of all schools—the working laboratory. Enough of work on each topic is given him to render him familiar with his subject. Much prominence is given to work that brings out the resources of the student himself, such as the construction of instruments and original investigation. He is encouraged to this and a regular portion of his time is set apart for this object.

It will be seen from the preceding statement that this course offers two great advantages: the thorough and extensive training of those intending to take part in the great development of Electric Science in the industrial field now going on and the facilities offered to those who wish to take a four years' course specially devoted to the whole branch of Physics.

The practical work of the Physical Laboratory is too extensive to allow of full details being given in the following arrangement of the course. The more important subjects developed may be mentioned here. In Mechanics, exact measurements, specific gravity, barometric leveling. In Heat, calorimetry and hygrometry. In Light, testing of

optical instruments, spectroscopic analysis and photometry. In Magnetism, study of laws of force, determination of moments of magnets and of horizontal components of intensity of earth's magnetism in absolute units. In Meteorology, observations for several months as taken in the U. S. Signal Service stations, with all the usual corrections and reductions; construction of charts; mapping curves; reports, etc. In Electricity, management of batteries, construction of instruments, electrical measurements, electrolysis and relation of electrical currents to heat and mechanical work; practical running and care and tests of dynamos; electric lighting, with photometric tests of arc and incandescent lamps; measurement of heat units given off by lamps, their resistance (hot and cold); energy consumed in lamps; spectroscopic tests of purity of carbons; study of telegraph and telephone and of the application of electricity to railways; visits to manufactories, working systems, electric railways, etc.

The degree of Electrical Engineer (E. E.) will be given to the graduates of this course.

FRESHMAN CLASS.

FIRST TERM.

See page 59.

SECOND TERM.

Mathematics.—Olney's University Algebra, Part III. (3) Plane and Spherical Trigonometry and Mensuration. Use of Logarithmic Tables. (2)

Chemistry.—Lectures and Laboratory Practice. Douglass and Prescott's Qualitative Analysis. (2)

French.—Grammar and Reader (continued). (3) Or *German.*—Grammar and Reader (continued). (3)

Drawing.—Projection Drawing and Descriptive Geometry. Warren's Elementary Projection Drawing. (3)

English.—Rhetoric. Essays. (2)

Gymnasium. (2)

SOPHOMORE CLASS.

FIRST TERM.

Mathematics.—Analytical Geometry: Olney's General Geometry. (4)

Mechanics, Sound and Heat.—(Theory, lectures and recitations.) (3)

Mechanics, Sound and Heat.—(Physical Laboratory.) (4)

Drawing.—Isometrical Drawing. Architectural Drawing. (2)

French.—Grammar. Reading. Or *German.*—Grammar. Reading. (2)

English.—Essays.

Gymnasium. (2)

SECOND TERM.

Mathematics.—Differential and Integral Calculus: Olney and Courtenay. (4)

Heat.—Continued. (Physical Laboratory.)

Magnetism.—(Recitations and Physical Laboratory.) (3)

French.—Grammar. O'Connor. Choix de Contes Contemporains. Dictation. (2) Or *German.*—Grammar. Reading. Dictation. (2)

Mechanics.—Theory of motion, statics, energy, center of gravity, moment of inertia and general equations of motion. (4)

Steam Engine.—Holmes' Steam Engine. (3)

English.—Essays.

Gymnasium. (2)

JUNIOR CLASS.

FIRST TERM.

Mathematics.—Courtenay's Calculus and Wood's Analytical Mechanics. (2)

French.—Readings. Dictation. Compositions. (2) Or *German.*—Readings. Dictation. Compositions. (2)

Conversation class in both languages optional throughout the year.

Light and Electricity, Static and Voltaic.—(Theory; text-books and lectures.) (3)

Light and Electricity, Static and Voltaic.—(Physical Laboratory.) (3)

Meteorology.—Text-book and practice. (1)

Strength of Materials.—Elasticity and strength of wood, stone and metals. Theory of beams, columns and shafts. (4)

Boilers.—Wilson. Strength, construction and wear and tear of boilers. (1)

Essays and Original Orations.

Gymnasium. (2)

SECOND TERM.

Dynamic Machines and Electric Lighting.—Theory; text-books and lectures. (3)

Dynamic Machines.—(Physical Laboratory.) (2)

Electric Lighting.—(Physical Laboratory.) (3)

French.—Readings. Compositions. Lectures on French Literature. (2) Or *German.*—Readings. Compositions. Lectures on German Literature. (2)

Machine Design.—Calculations for a High-Speed Steam Engine. Proportioning of such machine parts as come under the head of fastenings, bearings, rotating and sliding pieces, belt and toothed gearing, levers and connecting rods. (5)

Literature and History. (1)

Gymnasium. (2)

SENIOR CLASS.

FIRST TERM.

Applications of Electricity to Railroad, Telegraph and Telephone Systems, etc.—Theory; text-book and lectures. (2) (Physical Laboratory.) (5)

Machine Design.—Proportioning of Machine Parts (continued). (2)

Astronomy.—Young's General Astronomy. (3)

Graphical Statics of Mechanism.—Herrman-Smith. (2)

Scientific Readings.

Gymnasium.

SECOND TERM.

Applications of Electricity (continued). (3)

Measurement of Power. — Indicating of Steam Engines; dynamometer experiments. (1)

Dynamic Machines.—(Physical Laboratory.) Tests of Efficiency in Generators and Motors, etc. (1)

Physics.—Original Investigation. (5)

Lectures on English and American Literature. (2)

Christian Evidences. (1)

Preparation of Thesis.—(With laboratory work.)

Gymnasium.

THE COURSE IN CHEMISTRY.

This course of study is designed to prepare students for the profession of the Chemist, in connection with metallurgical establishments, sugar refineries, gas works, superphosphate works, electrical machinery manufactories, mining companies, etc., and the general consulting and analytical work of the Professional Chemist. It is also well adapted for the preparation of teachers of chemistry and as a preliminary course to the study of medicine. It is eminently practical, the student's time being largely occupied by practical work in the large, well equipped and well ventilated chemical laboratories, which were completed in 1885 and constitute the best constructed building for this purpose in this country. The museum of chemistry contains large collections of specimens, for illustrating the lectures on theoretical and applied chemistry.

Theoretical Chemistry.—Instruction in this subject begins with lectures four times a week, in the first term of the Freshman year. These lectures are fully illustrated by experiments, colored diagrams, working drawings and lantern pictures and specimens from the museum. They include a general introduction to Theoretical Chemistry, and a description of the non-metallic and metallic elements and their compounds, the general subject of inorganic

chemistry. The students are required to take notes of the lectures, and to pass a written examination at the end of the term.

In the second term of this year Stoichiometry and chemical problems and reactions are taught by recitations twice each week.

The study of Theoretical Chemistry is continued throughout the Sophomore year by recitations three times a week from Cooke's Chemical Philosophy and is concluded in the first term of Junior, by a course of lectures and recitations on Theoretical Organic Chemistry, four times a week. These lectures are illustrated by experiments and by specimens from the museum of Chemistry.

Written examinations are held at the close of each of the above courses.

ANALYTICAL CHEMISTRY.—Qualitative Analysis is taught in the second term of the Freshman year, by lectures, recitations and practical work in the Qualitative Laboratory, twelve hours of practical work per week being required. This laboratory is a large, well ventilated and well lighted room, and supplied with convenient working tables, vacuum filtration, hoods for noxious vapors, steam baths, gas and washing appliances and a commodious room for hydrosulphuric acid. Distilled water is delivered by faucet in this room and the other large laboratories. At the close of the term a practical examination is held in this subject.

After completing this course, Quantitative Analysis is pursued throughout the Sophomore and the first term of the Junior years. This subject is taught by lectures, recitations and practical work in the Quantitative Laboratory, which is equipped similarly to the Qualitative Laboratory, but is supplied in addition with apparatus for drying precipitates and residues, rooms for the chemical balances, for combustions, and for a reference library.

Twelve hours per week are required during the first term of the Sophomore year and fifteen hours during the second term of that year and the first term of the Junior year.

The course consists in Gravimetric and Volumetric Analyses, as applied to the substances given in the lists farther on, accuracy being required in the determination of each constituent.

At the close of each term written examinations are held upon the theory and practice of Quantitative Analysis.

Gas Analysis is taught by lectures and laboratory practice in the Gas Laboratory. This laboratory is supplied with full and complete apparatus for Gas Analysis, according to Bunsen's processes, as well as apparatus for some of the more rapid methods. Mixtures of gases are required to be analyzed by the students, within certain limits of error, and a written examination, on the theory and practice, is held at the close of the course.

Assaying.—The assaying of ores by furnace assay, together with gold and silver bullion analysis, by processes practiced in the United States Mint, is taught by lectures and practical work in the first term of the Junior year, nine hours of practical work per week being required. The course includes the assaying of ores of lead, tin, antimony, gold, silver and iron, coal, and gold and silver bullion.

The Assaying Laboratory is supplied with large working tables, twenty-nine crucible and two iron furnaces, and eight muffle furnaces, with adjoining rooms for balances, and gold and silver bullion analysis.

A certain accuracy of results and a written examination as regards theory and practice are required.

Organic Chemistry.—The practical work in this subject is performed in the second term of the Junior year, fifteen hours being required, with conferences and recitations each week. The laboratory for this work is equipped similarly to the Quantitative Laboratory, in addition being supplied with steam heat, cold water and air blast upon the working tables, and a full supply of apparatus for the various determinations and experiments, including combustion furnaces, furnaces for heating sealed tubes, mercury pump, Hoffman's, Dumas' and Meyers' apparatus for vapor densities, nitrometers, chemical balances, etc.

The course consists of determinations of specific gravities, melting points, boiling points, vapor densities, chlorine, bromine, iodine and sulphur of organic substances.

Combustion analysis, nitrogen determination, fractional distillation, and the preparation of several pure organic compounds and their analysis are included.

INDUSTRIAL CHEMISTRY.—A course of lectures is delivered upon this subject in the second term of the Senior year, illustrated by experiments, diagrams, lantern pictures and specimens from the museum of chemistry. The working laboratory for this subject contains an apparatus for making illuminating gas, an alcohol still, worm and doubler and a complete working model of a sugar refinery, including filters, vacuum pan and centrifugal. In connection with this laboratory is a room containing a photometer and apparatus for determining the sulphur, ammonia and specific gravity of illuminating gas; also a laboratory for the testing of alcoholic liquors, sugar, molasses, bone black, soap, petroleum, paints, dyes, superphosphates and other commercial products, with the necessary technical apparatus. The students make practical experiments in this direction, and, with an instructor, visit various industrial establishments in this neighborhood and in and around New York City.

TOXICOLOGY.—A course of lectures on this subject is given in the first term of the Junior year, illustrated by experiments and by the large collection of specimens of poisons from the museum of chemistry. This is supplemented by a short course of laboratory work on some of the common poisons.

SANITARY CHEMISTRY.—During the second term of the Senior year attention is given to the qualitative and quantitative examination of air, water, food, disinfectants, and other subjects connected with this branch of the science. Special apparatus is provided for this work, as recommended by the best authorities on the subject.

PHOTOGRAPHIC CHEMISTRY. — A well equipped Photographic Laboratory and dark rooms are provided, in which the students of the chemical course receive practical instruction.

PHYSIOLOGICAL CHEMISTRY.—The examination of urine, blood, etc., receives a proper amount of attention.

The course also includes instruction in physics, mineralogy, blowpipe analysis, metallurgy and geology, which are of great value to the chemist.

MICROSCOPY.—Instruction in the use of the Microscope is given in the second term of the Senior year.

In the first term of the Senior year the student is required to prepare a Thesis on some subject, selected by the Professor of Chemistry, involving practical work in the laboratory in addition to the literary labor, each graduate thus making a contribution to the progress of the science, as a preliminary to the reception of his degree.

The graduate of this course receives the degree of Analytical Chemist (A.C.).

Students, not candidates for a degree, are admitted for special courses in Chemistry, of which they will receive certificates.

The laboratories are under the immediate charge of the Professor and Instructors of Chemistry and are open to the students from 8 o'clock A.M. to 6 o'clock P.M., including Saturdays. Students are at liberty to work in the laboratories beyond the required hours as their time may permit. Students are charged for materials and apparatus consumed; with moderate care this expense need not exceed $50 per year.

FRESHMAN CLASS.

FIRST TERM.

See page 59.

SECOND TERM.

Mathematics.—Olney's University Algebra, Part III. (3) Plane and Spherical Trigonometry and Mensuration. Use of Logarithmic Tables. (2)

Chemistry.—Lectures and Laboratory Practice. Douglass and Prescott's Qualitative Analysis. (4)

French.—Grammar and Reader (continued). (3) Or *German.*—Grammar and Reader (continued). (3)

Stoichiometry. (2)

English.—Rhetoric. Essays. (2)

Gymnasium. (2)

SOPHOMORE CLASS.

FIRST TERM.

Chemical Philosophy.—Cooke. (3)

Quantitative Analysis.—Fresenius' Quantitative Analysis. (4)

The following analyses are executed by the student:

1. Iron Wire (Fe)
2. Potassium Dichromate (Cr_2O_3)
3. Barium Chloride (Ba, Cl, H_2O)
4. Magnesium Sulphate (MgO, SO_3, H_2O)
5. Disodium Hydrogen Phosphate (P_2O_5)
6. Rochelle Salt (K_2O, Na_2O)
7. Volumetric Determination of Chlorine.
8. Acidimetry (HCl, H_2SO_4, HNO_3, $HC_2H_3O_2$)
9. Alkalimetry (KOH, NaOH, NH_4OH, Soda Ash, Pearl Ash.)
10. Chlorimetry (Bleaching Powders)

Quantitative Analysis.—Conference. (1)

Physics.—Mechanics, Heat and Electricity. Lectures. (5)

French.—Grammar. Reading. (2) Or *German.*—Grammar. Reading. (2)

English.—Essays.

Gymnasium. (2)

SECOND TERM.

Physics.—Sound, Light and Meteorology. Lectures. (3)

French.—Grammar. O'Connor: Choix de Contes Contemporains. Dictation. (2) Or *German.*—Grammar. Reading. Dictation. (2)

Quantitative Analysis.—Fresenius' Quantitative Analysis. (5)

The following analyses are executed by the student:

11. Copper Ore (Cu)
12. Zinc Ore (Zn) By both Gravimetric and Volumetric Methods.
13. Lead Ore (Pb, S)
14. Silver Coin (Au, Pb, Ag, Cu)
15. Spiegeleisen (Mn)
16. Copper Alloys (complete analysis)
17. Ilmenite (TiO_2)
18. Iron Ore (complete analysis)
19. Limestone (complete analysis)
20. Coal (Volatile Matter, Fixed Carbon, Ash, H_2O, S, P)
21. Slag (complete analysis)

Quantitative Analysis.—Conference. (1)

Blow-Pipe Analysis.—Lectures, with Practice. Plattner, Brush, or Nason and Chandler. (1)

Chemical Philosophy. (3)

English.—Essays.

Gymnasium. (2)

JUNIOR CLASS.

FIRST TERM.

Toxicology.—Lectures. (2)

Quantitative Analysis.—Fresenius' Quantitative Analysis. (5)

The following analyses are executed by the student:

22. Guano (NH_3, P_2O_5, H_2O)
23. Clay (complete analysis)
24. Manganese Ore (MnO_2)
25. Mineral Water (complete analysis)
26. Pig Iron (complete analysis)
27. Nickel Ore (Ni, Co)
28. Carbon in Steel (Volumetric)
29. Gas Analysis.

Quantitative Analysis.—Conference. (1)

Organic Chemistry.—Lectures and Recitations. (4)

Crystallography.—Lectures, with practical exercises in the determination of crystals. (2)

French.—Readings. Dictation. Compositions. (2) Or *German.*—Readings. Dictation. Compositions. (2)

Conversation class in both languages optional throughout the year.

Essays and Original Orations.

Gymnasium. (2)

SECOND TERM.

Organic Chemistry.—Laboratory. (5)

Organic Chemistry—Conference. (1)

Metallurgy.—Metallurgical Processes. Furnaces. Refractory Building Materials. Combustion. Natural and Artificial Fuels. Metallurgy of Iron. (4)

French.—Readings. Compositions. Lectures on French Literature. (2) Or *German.*—Readings. Compositions. Lectures on German Literature. (2)

Mineralogy.—Descriptive Mineralogy, with practical exercises in the determination of minerals. E. S. Dana. (3)

Literature and History. (1)

Gymnasium. (2)

SENIOR CLASS.

FIRST TERM.

Metallurgy.—Of Copper, Lead, Silver, Gold, Platinum, Mercury, Tin, Zinc, Nickel, Cobalt, Arsenic, Antimony and Bismuth. (5)

Assaying.—Including the Assay by the dry methods of Gold, Silver, Antimony, Lead, Iron and Tin ores, Coal, Gold and Silver Bullion and rich Lead. Ricketts. (3)

Organic Chemistry.—Laboratory. (5)

Geology.—Williams' Lithology, with practical exercises in determining rocks. (3)

Preparation of Thesis.

Gymnasium.

SECOND TERM.

Industrial Chemistry.—Lectures. (3)
Industrial Chemistry.—Laboratory. (5)
Agricultural Chemistry.—Laboratory. (1)
Sanitary Chemistry.—Laboratory. (1)
Microscopy.—Laboratory. (1)
Geology.—Historic and Dynamic Geology. Lectures. Geikie. (2)
Christian Evidences.—Lectures. (1)
Lectures on American and English Literature. (2)
Gymnasium.

THE COURSE IN ARCHITECTURE.

The studies in this course are closely allied with those in civil engineering, the higher surveying, railroad work, mineralogy, geology and astronomy being omitted, instead of which architectural drawing and designing is substituted as seen in the following program. Instruction is also given in the history and æsthetics of architecture, in methods of heating and ventilating, in boilers and hoisting machinery, and in house drainage and sewerage.

During the first and second years the student lays the foundation for his professional work by the study of Mathematics, Physics, Mechanics, Drawing, Surveying, English, and French or German. The course in drawing includes the use of water colors, free-hand, projection and isometric drawing, and their application to the general plans for a small building. In surveying there is field practice in the use of instruments, and also map drawing, thus enabling the student to understand the application of the subject to landscape gardening, and to the location of buildings.

During the third and fourth years of the course the work is of a more professional character. The subject of construction familiarizes the student with brick, stone, cement

and other materials, with foundations and masonry, with arches, piers and walls, and with the stone-cutter's art. There is a full course in the theory and calculation of columns, beams and shafts, in the strength of materials and its application to roof trusses and bridges. Working drawings of arches, piers and roof trusses are made in detail. Plans and estimates are prepared for wooden, brick, stone and iron buildings, the work being done according to standard specifications. In connection with the course visits of inspection are made to the numerous engineering structures in the Lehigh Valley and vicinity.

The student who completes all the subjects of this course will receive the degree of Bachelor of Science in Architecture (B. S.).

FRESHMAN CLASS.

FIRST TERM.

See Page 59.

SECOND TERM.

Mathematics.— Olney's University Algebra, Part III. (3) Plane and Spherical Trigonometry and Mensuration. Use of Logarithmic Tables. (2)

Surveying.— Theory of Chain and Compass Surveying. Computation of Areas. Elements of Leveling. (1)

French.—Grammar and Reader (continued). (3) Or *German.*—Grammar and Reader (continued). (3)

Drawing.— Projection Drawing and Descriptive Geometry. Drawings and Sketches from measurements of Objects. (4)

English.—Rhetoric. Essays. (2)

Gymnasium. (2)

SOPHOMORE CLASS.

FIRST TERM.

Mathematics.— Analytical Geometry: Olney's General Geometry. (4)

Physics.—Mechanics, Heat, and Electricity. Lectures. (5)

French.—Grammar. Reading. (2) Or *German.*—Grammar. Reading. (2)

Drawing.—Isometric Drawing and Sketching. Architectural Drawing. Plans for a simple cottage. (2)

Surveying.—Use of the Compass, Level and Transit. Surveys and Maps of Farms. Colored Topography. (2)

English.—Essays.

Gymnasium. (2)

SECOND TERM.

Mathematics.—Differential and Integral Calculus: Olney and Courtenay. (4)

Physics.—Sound, Light and Meteorology. Lectures. (3)

French.—Grammar. O'Connor: Choix de Contes Contemporains. Dictation. (2) Or *German.*—Grammar. Reading. Dictation. (2)

Mechanics.—Theory of motion, statics, energy, center of gravity, moment of inertia and general equations of motion. (4)

Surveying.—Profiles and Contour Maps. Hydrographic and City Surveying. Use of the Plane Table. Topographical Drawing and Sketching. (3)

English.—Essays.

Gymnasium.

JUNIOR CLASS.

FIRST TERM.

Mathematics.—Courtenay's Calculus, and Wood's Analytical Mechanics. (2)

French.—Readings. Dictation. Compositions. (2) Or *German.*—Readings. Dictation. Compositions. (2)

Conversation class in both languages optional throughout the year.

Strength of Materials.—Elasticity and Strength of Wood, Stone and Metals. Theory of Columns, Shafts and Beams. Reports on the Testing of Materials. (4)

Construction.—Materials of Construction. Masonry. Foundations. Construction of Roads and Pavements. (2)

Drawing. — Shades, Shadows and Linear Perspective. Sketches and Designs for Ornaments and Simple Details. (6)

Essays and Original Orations.

Gymnasium. (2)

SECOND TERM.

French.—Readings. Compositions. Lectures on French Literature. (2) Or *German.* — Readings. Compositions. Lectures on German Literature. (2)

Roofs and Bridges. — Theory and Calculation of Strains in Roof and Bridge Trusses. Graphical Statics. (3)

Construction.—Stone Cutting, with practical Drawings. (2) Theory of Retaining Walls and Stone Arches. Designs for Piers and Stone Arches. (2)

Architecture.—Designs and Estimates for Brick and Stone Buildings. (5)

History.—The History of Architecture. (2)

Literature and History. (1)

Gymnasium. (2)

SENIOR YEAR.

FIRST TERM.

Roofs and Bridges. — Cantilever, Suspension and Arch Bridges. Designs for Plate Girders and Riveted Roof Trusses. (6)

Mechanics of Machinery.—Pile drivers, cranes and elevators. (2)

Boilers.—Strength, construction, and wear and tear of boilers. Wilson. (1)

Architecture. — Specifications and Estimates. Design for an Iron Building. (5)

Heating and Ventilation.—Systems of heating, lighting and ventilating buildings. (2)

Gymnasium.

SECOND TERM.

Hydraulics. — Efflux of Water from orifices, and flow in pipes and channels. Hydraulic Motors. (2)

Sanitary Engineering. — Collection, Purification and Distribution of Water. Systems of Water Supply. The combined and the separate System of Sewerage. Drainage and Sewerage Buildings. (4)

Roofs and Bridges.—Design for a Pin-connected Roof Truss, with Working Drawings. (3)

Architecture.—Building Superintendence. The Æsthetics of Architecture. Original Plans, Estimates and Specifications. (4)

Lectures on English and American Literature. (2)

Christian Evidences.—Lectures. (1)

Preparation of Thesis.

Gymnasium.

PHYSICAL CULTURE.

The Gymnasium is open morning, afternoon and evening, in all, 45 hours a week. Exercise in it is required of all students who are fitted to take it. Class drill with the Instructor and individual exercise are prescribed.

GRADUATING THESES.

Every student will be required to present a thesis upon some topic connected with his special course, as a necessary portion of the exercises for his final examination for a diploma. These theses shall be accompanied by drawings and diagrams, when the subjects need such illustration. The originals will be kept by the University, as a part of the student's record, for future reference; but a copy may be retained by the student, and be published, permission being first obtained from the President.

DIPLOMAS AND CERTIFICATES.

The Diploma is given only to those who have passed all the examinations in a regular course and is signed by the Secretary of the Board of Trustees and by the Faculty of the University. For all the partial courses a certificate is given, signed by the Secretary of the Faculty, and showing what the student has accomplished.

GRADUATE STUDENTS.

Graduate students wishing to remain a year or more and pursue a course of study as candidates for another Degree may do so with the sanction of the Faculty. Those wishing to take *special* courses of study will be afforded every facility for so doing.

POST-GRADUATE DEGREES.

M. A.

The Faculty will recommend for the Degree of Master of Arts any candidate, otherwise properly qualified, who, after taking at this University the Degree of Bachelor of Arts, shall pursue, for at least one year at this University, or two years elsewhere, a course of liberal study prescribed by the Faculty in at least two departments, pass a thorough examination in the same and present a satisfactory Thesis.

M. S.

The Faculty will recommend for the Degree of Master of Science any candidate, otherwise properly qualified, who, after taking at this University the Degree of Bachelor of Science, or any Degree in the School of Technology, shall pursue, for at least one year at this University, or two years elsewhere, a course of study prescribed by the Faculty in at least two departments, pass a thorough examination in the same and present a satisfactory Thesis.

Ph. D.

The Faculty will recommend for the Degree of Doctor of Philosophy any candidate, otherwise properly qualified, who, after taking at this University the Degree of Master of Arts or Master of Science, shall pursue, for at least one year at this University, or two years elsewhere, a course of advanced study prescribed by the Faculty, in at least two departments, pass a thorough examination in the presence

of the Faculty in the same and present a satisfactory Thesis giving evidence of original investigation.

The candidate shall have a good knowledge of Latin and either French or German.

The Theses presented by candidates for Post-Graduate Degrees shall be retained by the University.

Applicants for any of these degrees will be required to complete the prescribed work within the allotted time. Special action of the Faculty is required for any extension of time.

THE UNIVERSITY LIBRARY.

The Library building was erected by the Founder of the University in 1877, at a cost of One Hundred Thousand Dollars, as a memorial of his daughter, Mrs. Lucy Packer Linderman, and during the same year more than Twenty Thousand Dollars were contributed by her family and friends as a memorial fund for the purchase of books. By the will of the Founder of the University a fund of $500,000 has been given for the permanent endowment of the library.

The building is semi-circular in plan, with a handsome façade in the Venetian style of architecture. It is constructed of Potsdam sandstone with granite ornamentation. In the interior, the center is occupied as a reading space, fifty by forty feet, from which radiate the book cases, extending from floor to ceiling; two galleries affording access to the upper cases. Shelf room is now provided for one hundred and sixty thousand volumes. The building is thoroughly fireproof, well lighted, and heated by steam.

Seventy-nine thousand volumes are now upon the shelves, including many extremely valuable works. The list of periodicals numbers about one hundred and twenty-five, embracing as far as possible all departments of knowledge.

The Library is conducted strictly for consultation, and is open to the use of the public; both of which conditions are in accord with the terms of the gift.

REGULATIONS OF THE LEHIGH UNIVERSITY LIBRARY.

I. The Library is open every day, except Sundays and Legal Holidays, from 8 A.M. until 10 P.M., and on Sundays for the students and others connected with the University from 1.30 P.M. until 9.30 P.M.

II. Admission is free to all persons over 16 years of age.

III. Readers are required to write their names and addresses in the Daily Register of the Library. They also write the name of the book desired upon a Library Card, with their signatures, and present the same to the Director's Clerk, who supplies the book, retaining the card as a receipt. Before leaving the Library, readers return their books to the clerk, and receive their cards.

IV. The University Professors and Instructors, only, are allowed to take books from the Library Building.

V. No person is allowed to enter the alcoves, or remove any book from the shelves, without permission of the Director.

VI. Readers wishing to consult the more valuable illustrated works make special application for that purpose.

VII. In taking notes, pencils, and not pens and ink, are to be used.

VIII. Audible conversation and the use of tobacco are strictly forbidden in any part of the Library.

IX. Any person not conforming to these Regulations, will be denied the privilege of the Library.

X. Any person who defaces, in any way, any book, magazine or paper, or the furniture, or any portion of the building, in addition to being deprived of the privileges of the Library will be prosecuted according to law.

OBSERVATORY.

By the liberality of Robert H. Sayre, Esq., one of the Trustees of the University, an Astronomical Observatory was erected on the University grounds, and placed under the charge of the Professor of Mathematics and Astronomy.

In the dome of the Observatory is mounted an Equatorial Telescope, of six inches aperture, by Alvin Clark & Sons. The west wing contains a superior Sidereal Clock, by Wm. Bond & Sons: a Zenith Telescope, by Blunt, and a Field Transit, by Stackpole. There is also a Prismatic Sextant, by Pistor & Martins.

Students in Practical Astronomy receive instruction in the use of the instruments and in actual observation.

The grounds upon which the Observatory stands, consisting of seven acres of land adjoining the original grant, were presented to the University by Charles Brodhead, Esq., of Bethlehem.

During the entire course the student will have ample opportunity to familiarize himself with the practical work of the Observatory and Computing Room.

THE PACKER MEMORIAL CHURCH

is the recent and munificent gift of Mrs. Mary Packer Cummings, daughter of the Founder of the University. It is a large and magnificent Church, richly furnished and handsomely appointed in every particular. There is no more beautiful Church edifice in the State and it is one of the noblest in all the land.

THE UNIVERSITY MUSEUM.

In addition to the large collection illustrating all branches of Industrial Chemistry, the Museum includes collections in Metallurgy, Geology, Zoölogy, and Archæology.

The Metallurgical Cabinet already includes specimens illustrating the various processes for obtaining the more common metals.

The Zoölogical Cabinet includes the Werner collection of nearly all the types of American birds with their nests and eggs, and the Packer collection of recent shells.

The Geological Cabinet numbers over ten thousand specimens and includes the Palæontological, Mineralogical, Petrographic and Economic collections. The first contains good specimens of nearly all the common genera. The

Mineralogical division includes the Keim and Rœpper collections—the latter being especially complete and valuable from a crystallographic standpoint. The Petrographic division numbers several thousand specimens and, besides including numerous varieties of nearly all the rocks of the globe, contains a duplicate set from the collection of the Second Geological Survey of this State. The Economic division was formed and donated by Dr. James P. Kimball, Director of the Mint, and formerly Professor of Economic Geology.

The Cummings Archæological Cabinet numbers three thousand specimens and includes Dr. Stubbs' collection of Indian relics, weapons, and utensils.

THE CHEMICAL AND NATURAL HISTORY SOCIETY OF THE LEHIGH UNIVERSITY.

This Society was organized in the Fall of 1871, as "The Chemical Society," but was afterwards expanded, as its present title indicates, and admits, by election, students from all departments of the University.

The collections of Botanical and Zoölogical Specimens belonging to the Society are already important. During the past years persons have been sent to Texas and Brazil to collect specimens for these cabinets.

The Society has organized and maintained several courses of public scientific lectures.

Among the honorary members of the Society are more than one hundred of the most distinguished scientists in Europe and the United States.

THE ENGINEERING SOCIETY.

This Society was organized in 1873, and admits, by election, students in the Junior and Senior Classes. Its meetings are held fortnightly. At these, papers relating to engineering subjects are read and discussed. It issues quarterly "The Journal of the Engineering Society," to which the members and others contribute.

THE MINING CLUB.

This was organized in 1883 and takes from the Junior, Senior and Post-Senior Classes those members of the Mining School who excel in their studies or in practical experience in the subjects of the course.

THE ELECTRICAL ENGINEERING SOCIETY

was organized in November, 1887, by students in the Advanced Course in Electricity. Its object is to supplement the regular work of the department by the study and discussion of electrical subjects.

THE AGORA

is a Literary Society which meets semi-monthly. Only students in the School of General Literature are eligible to membership.

THE ATHENÆUM

is also a Literary Society, whose active membership is confined to the Sophomore Class. The meetings are held weekly.

THE CLASSICAL CLUB.

This organization was formed in the Spring of 1889 by students in the Classical and Latin-Scientific Courses. At its monthly meetings, papers upon philological, historical and archæological subjects are read by students belonging to the upper classes and are then discussed and criticised. Thus independent work is encouraged and correct methods of investigation are acquired. Reports upon new discoveries and reviews of recent books vary the proceedings and keep the members informed in regard to the advances of philological science.

THE UNIVERSITY GUILD

is a Society for the promotion of the religious, mental, moral and social life of the students of the University. The Right Reverend, the Assistant Bishop of Central

Pennsylvania, is Honorary President and the Chaplain of the University, Honorary Vice-President. Its meetings are held fortnightly at the residence of the Chaplain. It is an active and flourishing society of important and growing influence.

THE NATURAL SCIENCE CLUB OF THE LEHIGH UNIVERSITY.

The object of this organization is systematic study, in connection with field work, in Natural History and its associated subjects. Its members are engaged in making a survey, both botanical and mineralogical, of the region within a radius of five miles from the University and propose to collect an herbarium and mineralogical cabinet which shall contain specimens of all the plants and minerals within this district.

FOUNDER'S DAY.

On the second Thursday of October of each year, Commemorative Exercises are held in honor of the Founder of the University.

Thursday, October 9, 1890, the Twelfth Founder's Day was celebrated. An address was delivered by George William Curtis, LL.D., of New York City.

UNIVERSITY SERMON.

This sermon is preached on the Sunday before University Day.

The Rev. George Williamson Smith, D.D., LL.D., President of Trinity College, was the preacher on Sunday, June 15, 1890, in the Memorial Church.

THESES.

Theses on the following subjects were prepared by the graduating class of 1890:

"Design of an Iron Highway Cantilever and Viaduct across the Lehigh River at Bethlehem."

THOMAS C. J. BAILY, JR.

"Investigation of the Standpipes and Small Reservoirs in Bethlehem and Allentown."

FREDERICK RICHARD BARRETT.

"Design for a Highway Bridge between Bethlehem and South Bethlehem at New Street."

EDWIN HERBERT BEAZELL.

"Plan for a Ship Canal Lock, especially for the Nicaragua Canal."

ADOLPH CARDENAS.

"Investigations in the Utilization and Recovery of certain matter in Sludge, a waste product of Petroleum Refineries."

WILLIAM PHELPS CLEVELAND.

"Comparison of a Plate Girder with a Stone Arch for a Span of Eighty Feet."

WARREN SCOTT COPE.

"Fabrication and Examination of Beer."

JAMES BARLOW CULLUM.

"The Theory of Bowstring Trusses."

JOHN WILLIAM DE MOYER.

"Investigation of a Seventy-seven-foot Through Plate Girder on the Allentown Terminal Railway."

CLEMENT HEYSER DETWILER.

"Design of a Through Plate Girder of Ninety Feet Span."

CHARLES EDWARD FINK.

"Design of an Iron Highway Cantilever and Viaduct across the Lehigh River at Bethlehem."

FREDERICK ELMER FISHER.

"Discussion of the Efficiency of a Six-inch Eureka Turbine."

FRANK ROBERTS FISHER.

"The Development of the Constitution and the Formation of Political Parties."

HOWARD AUGUSTUS FOERING.

"Determination of the Systematic Errors in Engineers' Transits."

RALPH GOODMAN.

"The Investigation and Review of two Locomotive Turntables."

GEORGE ELLSWORTH GREENE.

"The Economy in Reheating Compressed Air."

HARRY WALTER HARLEY.

"The Construction, Operation and Maintenance of the Lehigh Canal."

DAVID GARTH HEARNE.

"Discussion of the Colt Disc Engine."

FREDERIC KIDDER HOUSTON.

"Experiments upon the Efficiency of a Hydraulic Ram."

WILLIAM VINCENT KULP.

"Plan and Estimate for a System of Sewers for the City of Allentown, Pa."

HENRY MEYERS KURTZ.

"Distillation of Spirits."

THOMAS SMITH LEOSER.

"Manufacture of Rails in the United States."

JOHN ELMER LITCH.

"Investigations concerning the Manufacture and Estimation of domestic and foreign Glues."

CHARLES HERBERT MILLER.

"Plan for a Water Supply for the Lehigh University."

GEORGE NAUMAN, JR.

"Discussion of a Roof Truss at the Station of the C. R. R. of N. J. in Jersey City, N. J."

ROBERT ENGLER NEUMEYER.

"The Morris Canal of the State of New Jersey."

WILLIAM CASSIDY PERKINS.

"Plan for the Prevention of Floods in Washington City."

ASA EMORY PHILLIPS.

"Soluble Food and Lacto-Preparata."

CHARLES WILTBERGER PLATT.

"Review and Criticism of the Water Works at Sing Sing, N. Y."

ALEXANDER POTTER.

"Discussion of Ice Machinery, with an Estimate of a Plant for the Bethlehems."

EDWARD WILLIAMS PRATT.

"Wells Patent Balanced Compound Expansion Engine."

EDWIN JAY PRINDLE.

"Experiments on Dynamic and Static Stresses on Nails."

WALLACE CARL RIDDICK.

"Steam and Hot Water Heating Apparatus."

JOHN STOVER RIEGEL.

"A Comparison of the Methods used in the Manufacture of Illuminating Gas, as carried on in the cities of New York and Philadelphia."

JOSEPH EDGAR SANBORN.

"Review of the Sewerage System of Mt. Holly, N. J."
HARRY JOHNS SHERMAN.

"Review of the Suspension Bridge at Reading, Pa."
WILLIAM CALVIN SHOEMAKER.

"Preservation of Wood."
MICHAEL DRUCK SOHON.

"An Original Hydraulic Device for Controlling Side Rolls of Tire Mill."
WILLIAM ALSTON STEVENSON.

"Design of Three Spans of a Steel Highway Bridge."
THEODORE ALFRED STRAUB.

"Test and Discussion of a Steam Blower."
FRANCIS DUPONT THOMSON.

"Wire-Rope Tramways."
CHARLES COOKMAN TOMKINSON.

"Design of a City Highway Bridge of One Hundred and Twenty Feet Span."
CLAUDE ALLEN PORTER TURNER.

"History of Cantilever Bridges, with Theoretic Discussions."
AARON HOWELL VAN CLEVE.

"The Boynton Bicycle Railway."
JOSÉ RAMON VILLALON Y SANCHEZ.

"The Hunt Locomotive."
HERBERT WRIGHT.

THESES FOR THE DEGREE OF E. M.

"Experiments on the 'Champion' Ventilator."

JAMES W. ANDERSON, B.S.

"A Description of the Spiegel Furnace of the Lehigh Zinc and Iron Co., with a Discussion of the Heat Distribution within it."

FREDERICK LOUIS GRAMMER, B.S.

"A Comparison of the Firebrick and the Iron-pipe Hot-Blast Stoves."

ARNOLD KARTHAUS REESE, B.S.

"A Review of the Dorrance Colliery Fans."

CLARENCE WALKER.

"Method of Mining the Mammoth Bed at Lost Creek, Pa."

SAMUEL DEXTER WARRINER, B.A., B.S.

UNIVERSITY DAY.

This day is the last of the academic year and falls in 1891 on the third Wednesday in June. On this day orations are delivered by members of the graduating class, and degrees are conferred.

EXERCISES ON JUNE 19, 1890.

Reading of Scripture and Prayer by the Rt. Rev. N. S. Rulison, D.D., Assistant Bishop of the Diocese.

Salutatory Oration.—"The Indian Question."

HOWARD AUGUSTUS FOERING.

Oration.—"The Conflict of Science."

FRANK RAYMOND COATES.

Oration.—"The Effects of Machinery on the Laboring Classes."

EDWIN JAY PRINDLE.

Oration.—"In Rome, but not a Roman."
AARON HOWELL VAN CLEVE.

Valedictory Oration.
WILLIAM VINCENT KULP.

Award of the Wilbur Scholarship to
ALFRED EMORY LISTER,
of Carbondale, Pa., first in rank in the Sophomore Class.

The Wilbur Prizes were awarded as follows:

Freshman Class, Mathematics, to
HENRY BROWN EVANS, of Dayton, O.
WILLIAM IRVIN BOYD, of Washington, D. C.

Freshman Class, French, to
NATHANIEL MONTGOMERY OSBORNE, of Norfolk, Va.

Freshman Class, German, to
CHARLES JOSEPH O'NEILL, of Washington, D. C.

Freshman Class, English, to
ROBERT CULBERTSON HAYS HECK, of Heckton Mills, Pa.

Freshman Class, Freehand Drawing, to
HARRY JACOB ATTICKS, of Lisburn, Pa.
WILLIAM PRICE MARR, of Shamokin, Pa.

The following degrees were conferred:

E. M.

JAMES W. ANDERSON, B. S.,
FREDERICK LOUIS GRAMMER, B. S.,
ARNOLD KARTHAUS REESE, B. S.,
CLARENCE WALKER, B. S.,
SAMUEL DEXTER WARRINER, B. A.

B. S.

HOWARD AUGUSTUS FOERING.

C. E.

THOMAS C. J. BAILY, JR.,
FREDERICK RICHARD BARRETT,
EDWIN HERBERT BEAZELL,
ADOLPH CARDENAS,
WARREN SCOTT COPE,
JOHN WILLIAM DEMOYER,
CLEMENT HEYSER DETWILER,
FREDERICK ELMER FISHER,
FRANK ROBERTS FISHER,
RALPH GOODMAN,
GEORGE ELLSWORTH GREENE,
DAVID GARTH HEARNE,
WILLIAM VINCENT KULP,
HENRY MEYERS KURTZ,
GEORGE NAUMAN, JR.,
ROBERT ENGLER NEUMEYER,
WILLIAM CASSIDY PERKINS,
ASA EMORY PHILLIPS,
ALEXANDER POTTER,
WALLACE CARL RIDDICK,
HARRY JOHNS SHERMAN,
WILLIAM CALVIN SHOEMAKER,
THEODORE ALFRED STRAUB,
CLAUDE ALLEN PORTER TURNER,
AARON HOWELL VAN CLEVE,
JOSÉ RAMON VILLALON Y SANCHEZ.

M. E.

HARRY WALTER HARLEY,
FREDERIC KIDDER HOUSTON,
JOHN ELMER LITCH,
EDWARD WILLIAMS PRATT,
EDWIN JAY PRINDLE,
JOHN STOVER RIEGEL,
WILLIAM ALSTON STEVENSON,
FRANCIS DUPONT THOMSON,
CHARLES COOKMAN TOMKINSON,
HERBERT WRIGHT.

B. S.

(In Mining and Metallurgy.)

FRANK RAYMOND COATES,
CHARLES ELLERY COXE,
HARRY KINZER LANDIS,
SAMUEL DEXTER WARRINER, B. A.

A. C.

WILLIAM PHELPS CLEVELAND,
JAMES BARLOW CULLUM,
THOMAS SMITH LEOSER,
CHARLES HERBERT MILLER,
CHARLES WILTBERGER PLATT,
JOSEPH EDGAR SANBORN,
MICHAEL DRUCK SOHON.

The Benediction was then pronounced by the Bishop.

THE WILBUR SCHOLARSHIP.

This Scholarship was founded in 1872 by E. P. Wilbur, Esq., of South Bethlehem, and is the sum of $200 awarded annually to the student in the Sophomore Class having the best record.

THE ALUMNI SCHOLARSHIP.

The Alumni Association of the University has established a Scholarship of the value of $250 per annum, subject to the following conditions:

1. That the Scholarship shall only be awarded to a student in need of it.

2. That the Scholarship shall not apply to the first year of any student's course; he must without this aid have gone through one year, and must be prepared to start the second year free from all conditions.

3. That the Scholarship shall not be continued to a student who shall at any time during his course carry any condition over eight weeks beyond the date of the examination in which he failed.

Subject only to the above conditions the disposal of the fund shall until otherwise directed be in the hands of the President of the University.

THE HENRY S. HAINES MEMORIAL SCHOLARSHIP.

Mrs. Henry S. Haines, of Savannah, Ga., has established a scholarship of the annual value of $200 which is to be devoted to the support at the Lehigh University, throughout his scholastic career, of one student in the School of Mechanical Engineering; the selection to be made by Mrs. Haines herself during her life-time.

WILBUR PRIZES.

By the generosity of E. P. Wilbur, Esq., a fund has been established yielding an annual income of $100, for distribution in prizes as the Faculty shall determine.

ALUMNI PRIZES FOR ORATORY.

The "Alumni Association of the Lehigh University" has established an Annual Sum of Fifty Dollars, to be distributed as prizes for excellence in Oratory, subject to the following

REGULATIONS.

1. The Contest shall be held on the 22d day of February, or on the day designated by the University to commemorate the birthday of Washington.

2. There shall be a first prize of $25, a second of $15, and a third of $10.

3. To entitle one to be a competitor he must be a member of the Junior Class, taking a regular course.

4. Subjects for the oration shall be announced at the beginning of the first term of every year, and upon one of these each competitor shall write an oration not to exceed eight minutes in delivery.

5. Each oration shall bear upon its first page a fictitious name or motto, and shall be accompanied by a sealed envelope, which shall be superscribed with the same name or motto, and an address by which it may be reclaimed. The envelope shall contain the real name and address of the writer, with the declaration that the oration is his own original work. The examiner, having adopted a standard of excellence, may reject any or all of the orations presented which do not attain to this standard; of such as do —should they be sufficient in number—the best six shall be chosen, and their envelopes opened. The others shall be returned to the address given with their envelopes unopened.

6. The Executive Committee of the Alumni Association, or a committee of not fewer than three to be appointed by them, shall hear the competitors whose orations shall have been approved, and the awards shall be made by a majority of these judges.

7. In awarding the prizes the judges shall consider both the literary merits and the delivery of each oration.

8. These rules are subject to amendment by the Faculty.

The next contest will take place February 22, 1891.

ENTRANCE EXAMINATION PAPERS.

Used at the Examination in 1890.

[Requests for other examination papers than those herein printed can not be granted.]

I.—ENGLISH GRAMMAR.

1. Principal parts of *beat*, *burst*, *lie*, *enter*, *inter*, *pay*, *play*, *rid*, *wet*, *whet*.

2. Classify phrases according to form; according to office in the sentence.

3. What is essential to a complete sentence?

4. Illustrate the case absolute.

5. What is a clause? Name kinds of clauses.

6. Plurals of *path*, *motto*, *money*, *attorney*, *day*, *sky*, *handkerchief*, *sheaf*, *talisman*.

7. Correct or justify:

a. The general was seldom or ever found sober enough to lead his command.

b. There is no temptation so great but it can be resisted or shunned.

c. Here are fifty pens; you will find that either of them will do.

d. Then dash him to earth; there let him lay.

e. The legislature sets to-day.

f. O help me! I will drown, nobody shall help me!

g. Neither of them could read nor write.

h. It had never been my intention to have convoked the grand council.

i. It is not him you harm in your calumny.

8. Analyze this sentence fully, naming and classifying clauses and phrases. Parse words in italics:

It was *also* true *that* the Earl of Lauderdale, *who*, *both* from his high talents *and from* the long imprisonment which he had sustained *ever since* the battle of Worcester, had a peculiar *title to be consulted* on Scotch affairs, strongly advised the king that he should suffer his northern *subjects to retain* possession of their darling form of worship.

II.—GEOGRAPHY.

Outline maps of the Eastern part of the United States and Asia, respectively, were furnished to each applicant and he was required to draw the boundaries of countries, provinces, states and territories, and name them; to place and name the capital or chief city of each, and the principal rivers and mountain systems.

III.—UNITED STATES HISTORY.

1. How did the English failures in the settlement of America begin? When and where? and who was at the head of these expeditions?

2. What is said of Vermont? What name was first given to Vermont? Who claimed its soil? What do you know about the claim of New York? How was it resisted?

3. How long was the peaceable resistance to the taxing acts of Parliament kept up? How was resistance made? Who were the Whigs? Who were the Tories and why did the Tories join in the agreement?

4. Give the years in which John Adams' administration began and ended, and the leading events of his administration.

5. What is said of the Whig Party in England? Why and when was the name "Whig" adopted in the United States, and by whom was it adopted?

6. What were the great battles of 1862 in the East? In the West? What were the results of the year's operations?

7. When was the Tenure of Office Act passed? What did it forbid? Why and how did the President disobey it? Give the name of the President.

8. What is the Impeachment? What body tries impeachments? What vote is necessary for conviction? Where does the Chief Justice preside? What punishment follows conviction?

9. What power over taxes is given to Congress? What power in relation to commerce?

10. How are presidential electors chosen? And who are not to serve as electors?

IV.—ARITHMETIC.

1. (*a*) Give rules for multiplication and division of common fractions.

(*b*) Give rules for position of the decimal point in multiplication and division.

(*c*) How many inches in a foot? in a metre? How many inches in a link? How many chains in a mile? How many square rods in an acre?

2. Find the value of the following expression reduced to a decimal fraction:

$$\frac{1\frac{2}{3}-\frac{1}{2}\frac{7}{}+6}{\frac{1}{1}\frac{6}{5}+10976}.$$

3. 5 miles 2 rods 3 feet $2\frac{1}{2}$ inches: how many kilometres? How many centimetres?

4. $16.75. Find interest, discount, and bank discount for 90 days at $3\frac{1}{2}$ per cent.

5. A can do a piece of work in 6 days, B in 7 days, and C in 10 days. A works $1\frac{1}{2}$ days, B $2\frac{1}{2}$ days. How long will it take C to finish it?

V.—GEOMETRY.

1. (*a*) What is a proposition? A theorem? A lemma? A corollary? An axiom? A postulate?

(*b*) When are two straight lines said to be perpendicular? When parallel?

(*c*) When is a polygon symmetrical with respect to a centre? With respect to an axis? What is the symmetrical figure of a straight line with respect to centre?

2. (*a*) Define similar polygons; the ratio of similitude of similar polygons. State the conditions which render two triangles similar.

(*b*) When is a straight line said to be divided harmonically? When in extreme and mean ratio?

(*c*) What is meant by the statement, "The angle at the centre is measured by the intercepted arc?" What is the unit surface? What is the maximum surface that can be enclosed by a given straight line.

3. If two parallel straight lines are cut by a third the alternate interior angles are equal, and conversely.

4. The three medial lines of a triangle pass through a common point.

5. On a given straight line construct a segment which shall contain a given angle.

6. The perpendicular from the vertex of the right angle to the hypotenuse is a mean proportional between the segments of the hypotenuse. Each side about the right angle is a mean proportional between the hypotenuse and the adjacent segment.

7. Construct a polygon which shall be similar to a given pentagon and equivalent to a given hexagon.

8. In terms of radius and apothem of a given regular polygon compute radius and apothem of a regular polygon of double the number of sides.

9. Of isoperimetric plane figures the circle has the maximum area, and conversely.

10. Any face-angle of a triedral angle is less than the sum of the other two.

VI.—ALGEBRA.

1. (*a*) Define algebra; an equation; root of an equation.

(*b*) Explain the process of dividing one fraction by another.

(*c*) State rule for finding lowest common multiple of quantities that are not readily factored.

2. (*a*) State how the sign of a root is determined.

(*b*) Give rule for finding highest common divisor when the quantities are not readily factored, and state the principles upon which it is based.

(*c*) Introduce the coefficients within the parentheses in the following:

$$a(b+c)^{\frac{1}{2}},\ a(b+c)^{2},\ a^{\frac{2}{3}}(b+c)^{\frac{3}{4}},$$

and state the principle involved.

3. (*a*) Explain the process of elimination by comparison.

(*b*) Define similar radicals, and state when a radical is in its simplest form,

(*c*) Define an arithmetical progression. State the relations (formulæ) among the parts of a geometrical progression.

4. Divide $\frac{x^3}{y^3}+\frac{5x^2}{12y^2}+\frac{39}{16}$ by $\frac{x}{3y^2}+\frac{1}{2y}$.

5. Reduce $\frac{x^3+y^3}{x^2-y^2}$, $\frac{a^4-16b^4}{a^3+8b^3}$, and $\frac{x^2+12x+18}{x+3}$ to simplest forms.

6. Extract the square root of 4.9 to three places, and explain the process.

7. Divide $1+\sqrt{-1}$ by $1-\sqrt{-1}$. Multiply $\sqrt{-x^2}$ by $\sqrt{-y^2}$.

Simplify $\frac{3}{\sqrt[3]{4}+\sqrt[4]{3}}$.

8. Solve $2\sqrt{b+x}-\sqrt{4a+x}=\sqrt{x}$; also

$$\sqrt{x+\sqrt{x}}-\sqrt{x-\sqrt{x}}=\frac{3}{2}\sqrt{\frac{x}{x+\sqrt{x}}}$$

9. Solve $\sqrt{a+x}+\sqrt{a-x}=\frac{12a}{5\sqrt{a+x}}$ also $\frac{8}{x^3}+2=\frac{17}{x^{\frac{3}{2}}}$.

10. Solve $\left.\begin{matrix}(x^2-xy=70)\\(xy-y^2=12)\end{matrix}\right\}$: $\left.\begin{matrix}(x+y=7)\\(x^2+2y^2=34)\end{matrix}\right\}$.

VII.—PHYSICS.

1. Define:

a. Kinetic Unit of Force.
b. Kilogram-meter.
c. Resultant Motion.
d. Joule.
e. Unit Quantity of Electricity.
f. Magnetic Field.
g. Wave Period.
h. Timbre or Quality.
i. Absolute Zero.
j. Ebullition.
k. Thermodynamics.
l. Diffraction.
m. Virtual Image.
n. Irradiation.

2. A piece of iron (sp. gr. 7.21) weighs 30 grams, what is its weight in turpentine (sp. gr. .87)?

3. With what velocity must a stone be projected vertically downward so that it will fall through 307.28 feet in 4 seconds?

4. What is the Peltier effect?

5. If the resistance of 1000 ft. of copper wire 5 mils in diameter is 431.7 ohms, what will be the resistance of 2000 ft. of iron wire 20 mils in diameter, iron having $\frac{1}{7}$ the conductivity of copper?

6. Describe a storage or secondary battery.

7. Ten cells each having an internal resistance of 4 ohms are arranged two abreast and the five pairs in series and give a current of $\frac{1}{3}$ ampere through an external resistance of 20 ohms; what is the E. M. F. of each cell?

8. A certain string vibrates 100 times per second. Find the number of vibrations of another string that is three times as long and weighing four times as much per foot and is stretched by double the weight.

9. Describe the sonometer.

10. What weight must drop from a height of 1000 ft. to convert 10 lbs. of ice at 15° F., into water at 60° F., if all the mechanical energy is converted into heat and applied to the ice? (Sp. ht. of ice .505.)

11. A kilogram of the vapor of alcohol at 80° C. passes through a copper worm placed in 10.8 kilograms of water at 12° C. the temperature of which is thereby raised to 36° C. The copper worm and the copper vessel in which the water is contained weigh together 3 kilograms. Required the latent heat of alcohol vapor. (Sp. ht. of copper .0939.)

12. How does the rapidity of evaporation vary?

13. How far must an arc lamp of 2000 c. p. be placed from a screen to give the same illumination as a 20 c. p. lamp at a distance of 3 ft.?

14. Describe the photographer's camera.

VIII.—LATIN.

I. Grammar.

1. Decline *poëma*, *domus*, *turris* and *filia*, marking the quantity of all penultimate and final vowels.

2. Give the demonstrative pronouns with the differences in meaning and use.

3. Decline *idem* and *alius* in all genders. Compare *gracilis* and *arduus*.

4. Mention the endings used in forming abstract nouns from adjectives. Form nouns from *malus* and *nobilis*.

5. Give the principal parts and inflect in the future indicative and present subjunctive active, *teneo*, *sto*, *gero* and *fio*, marking the quantity of all syllables. Give synopsis of *malo* in the second person singular. Also all the participles of *hortor*.

6. State the rules for the uses of the Ablative without a preposition. What cases follow *similis*, *recordor*, *sub*, *pareo?* Mention all the methods of expressing in Latin the purpose of an action. How are the supines used? After what verbs are two accusatives employed?

7. What feet are used in Vergil's Æneid and how are they arranged to form a verse? Explain the kinds of caesura.

II. Caesar.

Translate (*Bk. I*, 17):

Tum demum Liscus, oratione Caesaris adductus, quod antea tacuerat proponit: 'Esse nonnullos, quorum auctoritas apud plebem plurimum valeat, qui privatim plus possint, quam ipsi magistratus. Hos seditiosa atque improba oratione multitudinem deterrere, ne frumentum conferant, quod praestare debeant: si jam principatum Galliae obtinere non possint, Gallorum quam Romanorum imperia praeferre: neque dubitare [debeant] quin, si Helvetios superaverint Romani, una cum reliqua Gallia Haeduis libertatem sint erepturi.

Show how this may be changed into direct discourse. *Conferant* why subjunctive?

Translate (*Bk. IV*, 16):

Germanico bello confecto, multis de causis Caesar statuit sibi Rhenum esse transeundum; quarum illa fuit justissima quod, cum videret Germanos tam facile impelli ut in

Galliam venirent, suis quoque rebus eos timere voluit, cum intellegerent et posse et audere populi Romani exercitum Rhenum transire. Accessit etiam, quod illa pars equitatus Usipetum et Tencterorum, quam supra commemoravi praedandi frumentandique causa Mosam transisse, neque proelio interfuisse, post fugam suorum se trans Rhenum in fines Sigambrorum receperat, seque cum iis conjunxerat.

Give the construction of *sibi* and the principal parts of *audere*. Mention what events follow in this fourth book.

III. Cicero.

Translate (*Cat. II*, §3):

Ac si quis est talis, quales esse omnes oportebat, qui in hoc ipso, in quo exsultat et triumphat oratio mea, me vehementer accuset, quod tam capitalem hostem non comprehenderim potius quam emiserim, non est ista mea culpa, sed temporum. Interfectum esse L. Catilinam et gravissimo supplicio adfectum jam pridem oportebat, idque a me et mos majorum et hujus imperii severitas et res publica postulabat.

Why is *accuset* subjunctive?

Translate (*Cat. IV*, §14):

Sed ea quae exaudio, patres conscripti, dissimulare non possum. Jaciuntur enim voces, quae perveniunt ad aures meas, eorum qui vereri videntur ut habeam satis praesidii ad ea quae vos statueritis hodierno die transigunda. Omnia et provisa et parata et constituta sunt, patres conscripti, cum mea summa cura atque diligentia, tum multo etiam majore populi Romani ad summum imperium retinendum et ad communis fortunas conservandas voluntate.

What explanation is given of the title *patres conscripti?*

Did Cicero have the law on his side in the punishment of Catiline?

Translate (*Archias*, §14):

Nam nisi multorum praeceptis multisque litteris mihi ab adulescentia suasissem, nihil esse in vita magno opere expetendum nisi laudem atque honestatem, in ea autem persequenda omnis cruciatus corporis, omnia pericula mortis

atque exilii parvi esse ducenda, numquam me pro salute vestra in tot ac tantas dimicationes atque in hos profligatorum hominum cotidianos impetus objecissem.

Explain the subjunctives in this passage and the syntax of *parvi*.

Translate (*Manilian Law*, §53):

Quid? tum, per deos immortales! si plus apud populum Romanum auctoritas tua quam ipsius populi Romani salus et vera causa valuisset, hodie hanc gloriam atque hoc orbis terrae imperium teneremus? An tibi tum imperium hoc esse videbatur, cum populi Romani legati quaestores praetoresque capiebantur? cum ex omnibus provinciis commeatu et privato et publico prohibebamur? cum ita clausa nobis erant maria omnia, ut neque privatam rem transmarinam neque publicam jam obire possemus?

IV. Vergil.

Translate (*Bk. III*, *l.* 374):

Nate dea,—nam te majoribus ire per altum
Auspiciis manifesta fides: sic fata deum rex
Sortitur, volvitque vices; is vertitur ordo—
Pauca tibi e multis, quo tutior hospita lustres
Aequora et Ausonio possis considere portu,
Expediam dictis: prohibent nam cetera Parcae
Scire Helenum farique vetat Saturnia Juno.

Tell how this passage comes in the course of the narrative. Explain the proper names. Write out the third and fifth lines, marking off the feet and the caesuras.

Translate (*Bk. VI*, *l.* 398):

Quae contra breviter fata est Amphrysia vates:
'Nullae hic insidiae tales; absiste moveri;
Nec vim tela ferunt: licet ingens janitor antro
Aeternum latrans exsanguis terreat umbras,
Casta licet patrui servet Proserpina limen.
Troïus Aeneas, pietate insignis et armis,
Ad genitorem imas Erebi descendit ad umbras.
Si te nulla movet tantae pietatis imago,
At ramum hunc (aperit ramum, qui veste latebat) adgnoscas.'

V. Latin at Sight.

Translate:

Inde movit et pervenit ad oppidum Leptin, liberam civitatem et immunem. Legati ex oppido obviam veniunt, libenter se omnia facturos, quae vellet, pollicentur. Itaque centurionibus ad portas oppidi et custodiis impositis, ne quis miles in oppidum introiret aut injuriam faceret cuipiam incolae, non longe ab oppido secundum litus facit castra. Eodemque naves onerariae et longae nonnullae casu advenerunt; reliquae, ut est ei nuntiatum, incertae locorum Uticam versus petere visae sunt.—*De Bello Afr.* § *VII.*

VI. Latin Prose Composition.

On the following day they move their camp from that place. Cæsar does the same thing and sends ahead (*praemitto*) all his cavalry to the number of four thousand, which he had collected (*cogo*) from the entire province, to see in what direction (*pars*) the enemy are making their march (*iter*). These having followed the rear (*novissimum agmen*) too eagerly, engage in an unfavorable (*alienus*) place and a few of our men fall.

VII. Roman History.

1. Who were Camillus, Spurius Cassius, Coriolanus and Jugurtha?
2. Give an account of Hannibal's campaigns in Italy.
3. Who were the members of the two triumvirates and how did each die?
4. Give the career of Sulla with date and state what changes were made by him in the Roman Constitution.
5. Write a description of the civil troubles at the time of the Gracchi.

IX.—GREEK.

I. Grammar.

1. Write the following passage with proper breathings and accents:

και οστις τε υμων τους οικειους επιθυμει ιδειν, μεμνησθω ανηρ αγαθος ειναι. ου γαρ εστιν αλλως τουτου τυχειν. οστις τε ζην επιθυμει, πειρασθω νικαν. των μεν γαρ νικωντων το κατακαινειν, των δε ηττωμενων το αποθνησκειν εστιν.

2. Decline in the singular, *γέφυρα, μνᾶ, νεώς, ναῦς, κέρας*; in the plural, *σκιά, νοῦς, μήτηρ, ἱππεύς, γυνή, δόρυ.*

3. Compare the adjectives *φίλος, αἰσχρός, ταχύς, χαρίεις*, and decline the comparative of *ταχύς.*

4. Decline *οὗτος*; translate *of ourselves, to one another, the other* (of two), *of what kind?, whence?, then.*

5. Decline the Greek words for *one, four;* and translate *twenty times, twelfth.*

6. Give the principal parts of *γίγνομαι, τρέπω, βαίνω, στέλλω.*

7. Give the indicative in full and the synopsis (first form in each mood) of the aorist active and passive of *τίθημι.*

8. Inflect the pluperfect of *οἶδα*; the pluperfect (middle) of *τάττω.*

9. Name three classes of verbs that govern the genitive; five prepositions that govern the dative, with the meaning of each.

10. Translate *εἰς τὴν πόλιν ἀφικοίμην* and *εἰς τὴν πόλιν ἀφικοίμην ἄν*, and explain these two uses of the optative.

II. Xenophon.

Translate:

ὁσων δὲ δὴ καὶ οἵων ἂν ἐλπίδων ἐμαυτὸν στερήσαιμι, εἰ σέ τι κακὸν ἐπιχειρήσαιμι ποιεῖν, ταῦτα λέξω. ἐγὼ γὰρ Κῦρον ἐπεθύμησά μοι φίλον γενέσθαι, νομίζων τῶν τότε ἱκανώτατον εἶναι εὖ ποιεῖν ὃν βούλοιτο· σὲ δὲ νῦν ὁρῶ τήν τε Κύρου δύναμιν καὶ χώραν ἔχοντα καὶ τὴν σαυτοῦ σώζοντα· τὴν δὲ βασιλέως δύναμιν, ἣ Κῦρος πολεμίᾳ ἐχρῆτο, σοὶ ταύτην σύμμαχον οὖσαν. τούτων δὲ τοιούτων ὄντων τίς οὕτω μαίνεται, ὅστις οὐ βούλεται σοὶ φίλος εἶναι.

By whom was this said? to whom? when?

Explain the optatives *στερήσαιμι, ἐπιχειρήσαιμι, βούλοιτο*; the genitives *ἐλπίδων, τούτων*; the dative *ᾗ.*

Give the uncontracted forms of *ποιεῖν*, *ὁρῶ*, *ἐχρῆτο*.

Translate:

Ἐπεὶ δ' οἱ τελευταῖοι τῶν Ἑλλήνων κατέβαινον εἰς τὰς κώμας ἀπὸ τοῦ ἄκρου ἤδη σκοταῖοι, διὰ γὰρ τὸ στενὴν εἶναι τὴν ὁδὸν ὅλην τὴν ἡμέραν ἡ ἀνάβασις αὐτοῖς ἐγένετο καὶ ἡ κατάβασις εἰς τὰς κώμας, τότε δὴ συλλεγέντες τινὲς τῶν Καρδούχων τοῖς τελευταίοις ἐπέθεντο καὶ ἀπέκτειναν τινας καὶ λίθοις καὶ τοξεύμασι κατέτρωσαν, ὀλίγοι ὄντες. ἐξ ἀπροσδοκήτου γὰρ αὐτοῖς ἐπέπεσε τὸ Ἑλληνικόν. εἰ μέντοι τότε πλείους συνελέγησαν, ἐκινδύνευσεν ἂν διαφθαρῆναι πολὺ τοῦ στρατεύματος.

Give the present forms of *συλλεγέντες*, *ἐπέθεντο*, *κατέτρωσαν*, *ἐπέπεσε*, *διαφθαρῆναι*, and state where each is made.

III. Xenophon, at Sight.

Χαιρεφῶντα δέ ποτε καὶ Χαιρεκράτην, ἀδελφὼ μὲν ὄντε ἀλλήλοιν, ἑαυτῷ δὲ γνωρίμω, αἰσθόμενος διαφερομένω, ἰδὼν τὸν Χαιρεκράτην, Εἰπέ μοι, ἔφη, ὦ Χαιρέκρατες, οὐ δήπου καὶ σὺ εἷ τῶν τοιούτων ἀνθρώπων οἳ χρησιμώτερον νομίζουσι χρήματα ἢ ἀδελφούς; . . . . καὶ ὁ Χαιρεκράτης εἶπεν· Ἀλλ' εἰ μέν, ὦ Σώκρατες, μὴ μέγα εἴη τὸ διάφορον, ἴσως ἂν δέοι φέρειν τὸν ἀδελφὸν καὶ μὴ μικρῶν ἕνεκα φεύγειν· ἀγαθὸν γάρ, ὥσπερ καὶ σὺ λέγεις, ἀδελφὸς ὢν οἷον δεῖ· ὁπότε μέντοι παντὸς ἐνδέοι καὶ πᾶν τὸ ἐναντιώτατον εἴη, τί ὢν τις ἐπιχειροίη τοῖς ἀδυνάτοις;

γνώριμος, known.
διαφέρομαι, be at variance.
χρήσιμος, useful.
διάφορον, ground of quarrel.
ἐνδεῖν, lack.
ἐνάντιος, hostile.
ἐπιχειρεῖν, attempt.

IV. Homer.

Translate:

αἶσχρὸν γὰρ τόδε γ' ἐστὶ καὶ ἐσσομένοισι πυθέσθαι,
μὰψ οὕτω τοιόνδε τοσόνδε τε λαὸν Ἀχαιῶν
ἄπρηκτον πόλεμον πολεμίζειν ἠδὲ μάχεσθαι
ἀνδράσι παυροτέροισι, τέλος δ' οὔ πώ τι πέφανται.
εἰ περ γάρ κ' ἐθέλοιμεν, Ἀχαιοί τε Τρῶές τε,
ὅρκια πιστὰ ταμόντες ἀριθμηθήμεναι ἄμφω,
Τρῶες μὲν λέξασθαι ἐφέστιοι ὅσσοι ἔασιν,
ἡμῶν δ' ἐς δεκάδας διακοσμηθεῖμεν Ἀχαιοί,
Τρώων δ' ἄνδρα ἕκαστοι ἑλοίμεθα οἰνοχοεύειν,
πολλαί κεν δεκάδες δευοίατο οἰνοχόοιο,
τόσσον ἐγώ φημι πλέας ἔμμεναι υἷας Ἀχαιῶν

Τρῶων, οἱ ναίουσι κατὰ πτόλιν. ἀλλ' ἐπίκουροι
πολλέων ἐκ πολίων ἐγχέσπαλοι ἄνδρες ἐνεισιν,
οἵ με μέγα πλάζουσι καὶ οὐκ εἰῶς' ἐθέλοντα
Ἴλιον ἐκπέρσαι, ἐὺ ναιόμενον πτολίεθρον.

Write the attic forms of *ἐσσομένοισι, ἀριθμηθήμεναι, ἔασιν, δευοίατο, πλέας, ἔμμεναι, πολλέων, πολίων.*

By whom were these lines spoken? on what occasion?

Translate:

ἡμέων δ' ὁπποτέρῳ θάνατος καὶ μοῖρα τέτυκται,
τεθναίη· ἄλλοι δὲ διακρινθεῖτε τάχιστα.
οἴσετε δ' ἄρν', ἕτερον λευκὸν ἑτέρην δὲ μέλαιναν,
γῇ τε καὶ ἠελίῳ· Διὶ δ' ἡμεῖς οἴσομεν ἄλλον.

Where is *τεθναίη* made? *διακρινθεῖτε*? *οἴσετε*?

Divide these four lines into feet, giving quantity of each syllable.

V. History.

1. Give a brief account of Draco; of Solon; of Cleon; of Lysander.

2. Where was Leuctra? When was the battle of Leuctra fought? Who were the combatants? What was the result?

3. Who was Kleisthenes? What did he do?

4. When did the Peloponnesian War begin? When did it come to an end? Where was the last battle fought? What were its results?

5. Give a brief account of the life of Demosthenes.

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